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A systematic review to identify and assess the effectiveness of alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission.

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ABSTRACT

Background / objectives

There are some older patients who are 'at the decision margin' of admission. This systematic review sought to explore this issue with the following objective: What admission alternatives are there for older patients and are they safe, effective and cost-effective? A secondary objective was to identify the characteristics of those older patients for whom the decision to admit to hospital may be unclear.

Design

Systematic review of controlled studies (April 2005-December 2016). The protocol is registered at PROSPERO (CRD42015020371). Studies were assessed using the Cochrane risk of bias criteria, and relevant reviews were assessed with the AMSTAR tool. The results are presented narratively and discussed.

Setting

Primary and secondary health care interface.

Participants

People aged over 65 years at risk of an unplanned admission.

Interventions

Any community-based intervention offered as an alternative to admission to an acute hospital

Primary and secondary outcomes measures

Reduction in secondary care use, patient-related outcomes, safety and costs.

Results

Nineteen studies and 7 systematic reviews were identified. These recruited patients with both specific conditions and mixed chronic and acute conditions. The interventions involved paramedic/emergency care practitioners (n=3), emergency department-based interventions (n=3), community hospitals (n=2), and hospital-at-home services (n=11). Data suggest that alternatives to admission appear safe with potential to reduce secondary care use and length of time receiving care. There is a lack of patient-related outcomes and cost data. The important features of older patients for whom the decision to admit is uncertain are: age over 75 years, co/multi-morbidities, dementia, home situation, social support and individual coping abilities.

Conclusions

This systematic review describes and assesses evidence on alternatives to acute care for older patients and shows that many of the options available are safe and appear to reduce resource use. However, cost analyses and patient preference data is lacking.

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STRENGTHS AND LIMITATIONS OF THIS REVIEW

1. High quality systematic review of controlled studies.
2. Specific focus on admission avoidance interventions for acute care of older people.
3. Studies cover a wide range of acute conditions and acute exacerbation of chronic conditions in older people.
4. Some of the studies are pragmatic in approach and are at high risk of bias.
5. Most studies do not provide associated costs/cost analyses of interventions or patient preference data.

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Introduction

Reducing emergency bed days is one of the biggest challenges currently facing the National Health Service (NHS) in the United Kingdom. There is considerable pressure to reduce hospital admissions amongst older people.[1] It has been suggested that clinicians should: 'choose to admit only those frail older people who have evidence of underlying life-threatening illness or need for surgery'.[2] There has been a 65% increase in hospital admissions for those over 75 years of age in the last decade. Furthermore, people over 85 years of age now account for 11% of emergency admissions and 25% of critical care bed days.[3] Decisions to admit to an acute hospital are often influenced by inadequate knowledge of the patient or condition, communication difficulties between primary and secondary care, perceived benefits of in-patient care and patient preferences.[4] A review of urgent and emergency care by NHS England highlighted the need to identify those frail and elderly people who need care but do not have a medical need requiring hospital admission.[3] It is clear that there are some older patients for whom care in the community is safe, perhaps with the provision of additional services, and some for whom admission is required in order to deliver diagnostics or treatment that are only available in hospital. However, for those patients 'at the decision margin', the best path of action may be unclear.[5] The decision may be affected by non-clinical and clinical factors e.g. multi-morbidity, support at home or how much risk the patient or family are willing to accept.

Our specific objective was to conduct a systematic review to identify studies of community-based interventions aimed at reducing secondary care use in older patients with acute medical problems potentially requiring unscheduled hospital

admission. A secondary objective was to further confirm the characteristics of those older patients for whom the decision to admit to hospital may be unclear.

Methods

Protocol and registration

The protocol for the systematic review was registered at the PROSPERO register on 14/06/2015. Registration number is: CRD42015020371 (Supplementary material)

Eligibility criteria

Publications of any randomised controlled trial (RCT) or controlled observational study (COS) that described people aged over 65 years, of either sex living in Organisation for Economic Co-operation and Development countries being considered for an unplanned admission were eligible for inclusion. The control was acute hospital admission. The studies had to include at least one of the following as either a primary or secondary outcome: intervention effectiveness, patient related outcomes, safety outcomes or healthcare costs, otherwise they were excluded.

Information sources and searches

Medline, Medline In-Process, Embase, Cinahl and CENTRAL databases were searched from January 2005 to April 2015 inclusive using search terms based on the eligibility criteria. (Appendix 1) An update was run in December 2016 across Medline and Medline In-Process. We included any relevant systematic reviews published between 2010 and 2016. The decision to time limit the searches was based on the fact that the systematic reviews would cover any older studies and that any evidence not included in these two sources was unlikely to be relevant to the fast changing primary and secondary health care interface. The King's Fund and

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Agency for Healthcare Research and Quality websites were also searched in April 2015.[6,7] The resulting references were managed using EndNote X6 software.

All references were screened by title and abstract followed by full text, both independently and in duplicate (AH, BD), using predefined inclusion/exclusion criteria. Any disagreements in either stage were resolved using a third reviewer (SP). The reference lists of included studies were checked and forward referencing was conducted using Google Scholar. Authors of included studies were contacted for details of any extra studies.

Data items and collection process

Data from all primary studies (2005-2016) were extracted into a custom-designed table. The main results and conclusions of recent high quality systematic reviews (2010-2016) which included relevant primary studies were also recorded.

***Assessment of risk of bias of individual studies* (Appendix 2)**

The Effective Practice and Organisation of Care Cochrane risk of bias tool was used to critically appraise RCT or COS publications.[8]

***Assessment of methodological quality of systematic reviews* (AMSTAR) *(*Appendix 3)**

The AMSTAR checklist was used to assess the quality of the included systematic reviews.[9]

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Synthesis of results

The data are presented narratively describing, if present, the most relevant systematic review and individual studies for each intervention and, where appropriate, for a specific condition.

In order to identify the characteristics of those older patients for whom the decision to admit to hospital may be unclear, the inclusion/exclusion criteria and demographics of the various studies' participants were examined and key features were tabulated alongside the number and references of relevant studies.

Results

The systematic review identified four types of intervention from across 19 studies published in 24 individual papers: paramedic/emergency care practitioners (n=3), emergency department (ED) interventions (n=3), community hospitals (n=2), hospital-at-home services (n=11).[10-33] [Figure one](Appendix 4) Fifteen of the studies were conducted in western European countries of which four were in the UK. Two studies were conducted in Australia and two studies in the United States (US). Risk of bias, general intervention description, AMSTAR and study data are detailed in Appendices 2-5.

Paramedic practitioner/emergency care practitioner (PP/ECP) interventions

Three studies were identified.[10-12] A cluster RCT (Mason 2007), compared PPs with additional training (n=1469) with standard PPs (n=1549) in assessing and treating elderly people following 999 calls with the aim of measuring subsequent emergency care.[10] Similarly, two more recent COS investigated the role of ECPs in avoiding ED) attendance/admissions in elderly populations.[11, 12] Gray 2008 was a case-series

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study of ECP attendances for elderly patients aged over 65 years with a fall (n=233) compared with historical controls (n=772), and Mason 2012 was a cluster controlled study of enhanced ECP care for five care homes (n=256) compared with standard care in five other care homes (n=201). Risk of bias was low for all the domains of the cluster RCT and both of the COS were at high risk due to lack of randomisation.

In the cluster RCT, all primary outcomes comparing the intervention with the control group were improved: relative risk of ED attendance within 28 days (RR 0.72 (0.68, 0.75)), relative risk of hospital admission within 28 days (RR 0.87 (0.81, 0.94)), being very satisfied with care (RR 1.16 (1.09, 1.23)) and mean total episode duration in hours (-42.2 (-59.5,-25.0)) with a reported p<0.001 for all.[10] The secondary outcome of mortality was comparable between groups, but intervention patients had a greater number of subsequent unplanned contacts with secondary care at 28 days (330 vs. 259 p<0.01).

The two COS reported a greater reduction in admissions when comparing the intervention with normal ECP practice but these results are of limited use due to the high risk of bias of the studies.[11, 12]

None of the studies of PP/ECP interventions provided details of cost data or cost-effectiveness analysis.

Emergency department (ED) interventions

The searches identified one RCT (Sun 2014) which was assessed to be at low risk of bias, and two COS (Benaiges 2014, Salvi 2008) in which the risk of bias was high for several domains including randomisation.[13-15]

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Sun and colleagues conducted a RCT in which patients attending ED with syncope were randomised to receive either a syncope protocol in an observation unit (n=62) or usual care (n=62).[13] where the maximum stay in the observation unit could not exceed than 24 hours.

In terms of primary outcomes, patients randomised to the intervention spent less time in hospital at the index visit (29 vs. 47 hours p<0.001) and were less likely to be admitted to hospital (RR 0.16 (95% CI 0.09, 0.29) p<0.001). There were no differences in the secondary outcomes of serious events, quality of life (QoL) or satisfaction with care between groups. A reduction in costs was reported but no formal statistical comparison was performed (index visit US$1400 vs. 2420, 30 days US$1800 vs.2520 (2011 data)).

The first of the two COS compared usual care with treatment in a 'day hospital' for hyperglycaemic crisis from which the main result was improved readmission rates and associated costs (Benaiges 2014), whilst the second COS compared a specialist geriatric ED intervention with a standard ED procedure (Salvi 2008) but without evidence of any differences in outcome and had significant differences in baseline demographic data. [14,15]

Community hospital (CH) interventions

Two RCTs were identified describing a community hospital (CH) intervention as an alternative to acute hospital (AH) care.[16-19] Both RCTs were at low risk of bias overall. In the RCT by Vicente, participants were randomised following triage at home to either go to a CH (n=410) or to the ED (n=396).[16] The data presented were limited. The authors reported that the nurse attending the patient at home sent 90

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intervention participants to the CH (primary outcome) although six of those individuals were subsequently transferred from the CH to the ED (secondary outcome). There were no formal statistical analyses nor were cost data presented.

The Garåsen RCT compared CH care (n=72) to AH care (n=72) and was published over three separate papers. [17-19] There was no distinction between primary and secondary outcomes. At 26 weeks, there were fewer readmissions in the CH group versus the AH group (19% vs. 36%, p=0.02) and more people receiving no care (25% vs. 10%, p=0.01). At 12 months, there were fewer deaths in the CH group (18% vs. 31%, p=0.03) although the observation period was considerably longer in the CH group (335.7 vs. 292.8 days, p=0.01). Total cost of treatment was less in the CH group compared with those receiving AH care NOK 39,650 ((95% CI kr 30 996-48,304) versus NOK 73,417 (95% CI NOK 52 992-93,843)) data collected 2003-2005 (p = 0.002). Average health services costs per patient/day for the entire observation period was NOK 606 (95% CI £ 450- 761) in the CH group compared to NOK 802 (95% CI NOK 641-962) in the AH group (p = 0.026).

Hospital-at-Home (HaH) interventions

Eight of the HaH studies were focused on specific conditions: heart failure (n=3), chronic obstructive pulmonary disease (n=1), pulmonary embolism (n=1), pneumonia (n=1), stroke (n=1), and uncomplicated diverticulitis (n=1). [20-28] The remaining three HaH studies recruited older participants with a range of conditions, and two of these recruited from residential homes and were not included in recent high quality systematic reviews.[29-33] All the specific condition studies were included in recent (2010-2016) systematic reviews.[34-40]

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Heart failure (HF)

Three RCTs were identified on HaH for HF and their results published in four separate papers.[20-23] These studies were included in two previous reviews of HaH one which focused on HF (Quaddoura 2015).[34,35] This review used the Cochrane risk of bias tool and described the overall quality of the RCTs as modest. The AMSTAR rating of the review highlighted a lack of description of excluded studies and the combination of different QoL measures in meta-analysis.

The patients were randomised to either HaH or AH within the ED and the primary outcomes of the review were hospital readmissions and mortality. HaH increased time to first readmission (mean difference (MD) 14.13 days [95% CI 10.36, 17.91] p=0.015 using data from two RCTs (n=132).[22-23] although there was no strong evidence of an effect on the rate of readmission (RR 0.68 [0.42, 1.09]) using data from two RCTs (n=172).[20,22] This is a sizeable reduction, but consistent with chance in a data set of this size. An improvement was reported in health-related QoL at both 6 and 12 months (standardized MD (SMD) -0.31 [-0.45 to -0.18]; SMD -0.17 [-0.31 to -0.02] respectively). HaH was comparable to AH care on all-cause mortality (RR 0.94 (0.67, 1.32)) using data from all three RCTs. These studies also showed a significant reduction in costs for the index treatment period (p<0.001). Two trials[20,23] reported lower costs in the HaH group at 12 months, although the difference was not statistically significant in one of the studies.[20] When the authors of this particular review calculated total costs for these two trials, both indicated a cost reduction for HaH compared to AH care.

Chronic obstructive pulmonary disease (COPD)

An RCT by Ricauda was published in 2008 and was also included in two recent systematic reviews - one focusing on COPD and one more generally on HaH.[24,35,36]

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The high quality COPD review included eight RCTs, one of which described HaH in an early discharge setting, plus the Ricauda trial and six which were published prior to our 2005 inclusion date.

The Ricauda RCT compared HaH (n=52) with AH (n=52) and was conducted with low risk of bias. The primary outcomes were hospital readmission and mortality rates at 6 months. The secondary outcomes included a range of depression, functional, cognitive and nutritional measures as well as costs.

The study showed that there were fewer hospital readmissions for HaH patients compared to AH patients at 6 months (42% vs 87%, p=0.001) although HaH patients had a longer length of stay than those in the AH group (15.5 SD±9.5 vs 11.0 ±SD 7.9 days, p=0.01). Whilst HaH patients experienced improvements in depression and QoL scores during the study, there was no evidence of difference between the two groups for these outcomes at 6 months. Cumulative mortality at 6 months was comparable between groups (20.2%).

All patients discharged from HaH completed the care programme at home, whereas 11.5% of AH patients continued their care in a long-term facility after hospital discharge, with an average daily cost of $174.7 for a mean period of 25 ±8.7 days. Overall - on a cost per patient per day basis - HaH care was less expensive than that given to the AH group ($101.4 ± 61.3 vs $151.7 ±96.4, p=0.002). This RCT reflected the results of the previously published systematic review.[36]

Pulmonary embolism

Our review identified one published COS of HaH (Rodriguez-Cerillo 2009) for patients with pulmonary embolism which was also included in a recent systematic

review with seven other observational studies (Vinson 2012).[25,37] The high quality review concluded that the overall incidence of mortality at 90 days was very low.

The COS compared HaH (n=30) with AH (n=31) and was at high risk of bias overall.[25] No distinctions between primary and secondary outcomes were made. Mean length of stay was not statistically different comparing HaH with the AH group (8.9 days (7–14 days) vs. 10.6 days (6–20 days)). No patients treated at home required unexpected return to hospital during admission. There was no major bleeding, thrombosis or death in either group at 90 days in the COS. [25] There were no cost data reported.

Pneumonia

Our review identified one RCT (Carratala 2005) published and included in a recent systematic review (Chalmers 2011) which also described a further five studies comprising a variety of designs).[26,38] The RCT compared HAH (n=110) with AH (n=114) and was at low risk of bias. The primary outcome was the percentage of patients with an 'overall successful outcome' according to seven predefined criteria [26] whilst secondary outcomes were patients' QoL and satisfaction.

An overall successful outcome was achieved in 83.6% of HaH patients and 80.7% of AH patients (absolute difference 2.9% [95% CI, 7.1-12.9]). Subsequent hospital admissions were comparable between groups (6.3 vs. 7.0%). More HaH patients were satisfied with their overall care (91.2 vs. 79.1%; ab 12.1% [CI, 1.8 to 22.5%]). Reported QoL scores were comparable between groups as was the percentage of patients with adverse drug reactions (9.1 vs. 9.6%), medical complications (0.9 vs. 2.6%), and overall mortality (0.9 vs. 0%) for HAH and AH patient groups

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respectively. There were no cost data presented. This RCT data reflects the result of the systematic review by Chalmers 2011. [38]

Stroke

One RCT on HaH for stroke patients (Kalra 2005) was published and also included in two previous systematic reviews.[27,35,39] This RCT was at low risk of bias. The primary outcome measure was death or institutionalisation at one year. This three-arm study randomised patients into care on a stroke unit (SU) (n=152), care in a general ward (GW) with stroke expert advice (n=152) and HaH with stroke expert advice (n=153) within 72 hours after recruitment in the ED department. Mortality and institutionalisation at one year were lower in the SU group compared with either the GW (14 vs. 30%, $p < 0.001$) or HaH groups (14 vs. 24%, $p=0.03$). Significantly fewer patients cared for on the SU died compared with those in the GW group (9 vs. 23%, p = 0.001). The SU group showed greater improvement on basic activities of daily living compared with the other two groups (change in Barthel Index 10 vs. 7, $p < 0.002$). QoL at three months was significantly better in SU and HaH patients. There was greater dissatisfaction with care in the GW group compared with SU or HaH groups. The total costs of stroke care per patient over 12 months (data collected 2005-2008) were £11,450 for the SU group, £9527 for GW group and £6840 for HaH group.

Uncomplicated diverticulitis

Our systematic review found one COS (Rodriguez-Cerrillo 2013).[28] This study was also included in a recent, moderate quality integrative review on admission-avoidance HaH services.[40] This COS compared HaH (n=34) with AH (n=18) for patients with uncomplicated diverticulitis and was, overall, at high risk of bias with no

defined primary or secondary outcomes were defined. No statistical detail was provided about any of the data presented. None of the patients treated at home were transferred to the acute hospital. The mean length of stay in the intervention group was 9 days, compared with 10 days in AH. HaH treatment was associated with a cost reduction of €1368 per patient.

Older population with acute medical problems

One COS recruited acutely ill older persons and was published across three separate papers (Leff 2005, main publication).[29-31] This COS compared HaH (n=169) with AH (n=286) with the majority of patients being identified the morning after admission. The study was at high risk of bias.[29] There was no distinction made between primary and secondary outcomes. Patients treated with HaH had a shorter length of stay compared with those given AH care (3.2 vs. 4.9 days, p =0.004). The mean treatment cost was lower for HaH care than for acute hospital care ($5081 vs. $7480, p< 0.001). Eight weeks after admission, there were no differences in the use of health services between HaH and AH patients in terms of ED visits, (0.23 (SD 0.66) 0.22 (SD 0.57)) or readmission (0.28 (SD 0.59) 0.27 (SD 0.55)).

The COS by Crilly 2010 recruited elderly nursing home patients presenting at ED but who were willing to receive care back in their nursing home (n=62) and compared these with historical control care home patients who had been hospitalised (n=115). The study was at high risk of bias [32] and no primary outcomes were specified. Intervention participants experienced a longer time in ED than those who had been admitted into hospital (9.94 vs. 7.01 hours p=0.005) but required less time being subsequently cared for (2.19 vs. 6.2 days p<0.001). Overall, the length of an episode of care in days (9.56 (1.26) vs. 6.20 (0.59) days, p=0.14) and the number of

readmissions within 28 days (11.3 vs. 11.3, p=0.99) were not statistically different between the two groups. There were no mortality or cost data presented.

The COS by Lau 2013 assessed residents of a care home presenting at ED who were subsequently treated back in their care home (n=95) and compared data with historical hospital controls (not from care homes) (n=167).[33] No primary outcomes were specified and the study was at high risk of bias. Length of stay was significantly shorter for those in the intervention group compared with the controls (2.0 vs. 11.0 days p<0.001) although mortality (11 (11.6%) vs. 20 (12.0%), p=0.924) and readmission rates (39 (41.1%) vs. 68 (40.7%), p=0.963) at 6 months were comparable between groups. There were no cost data presented.

Characteristics of those older patients for whom the decision to admit to hospital may be unclear *(*Appendix 6)

Fifteen of the studies included in our systematic review recruited a population with a mean age of more than 75 years, despite the inclusion criterion specifying those over 65 years. Whilst 9/19 studies specifically stated their recruited population was multi-morbid, it is plausible that all the study populations were and so this is very likely to be a factor which impacts on decision-making in acute medical care. Eight studies specified a particular degree of severity for dementia as an inclusion criterion but, in practice, this is a difficult assessment to make in the acute care context. There were inclusion/exclusion criteria in nine of the studies which specified the importance taking account of an individual's home situation, social support networks and coping abilities as part of the decision-making process.

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Discussion

The findings of our systematic review show that alternatives to acute hospital care at the point of potential admission for people aged over 65 years can be safe, with comparable mortality and clinical outcomes across a range of acute and chronic conditions. They also have the potential to reduce healthcare spending. The key features of older patients for whom the decision to admit may be uncertain are age more than 75 years, co/multi-morbidities, dementia, home situation, social support and individual coping abilities.

Our systematic review was conducted to high methodological standards.[41] The majority of evidence presented is based on HaH services, although this includes treatment of a wide range of conditions. Whilst not all the included studies were randomised or considered to be at low risk of bias, these issues are clearly highlighted and the included studies cover a variety of alternative approaches to hospital admission. The majority of the included studies offer little or no cost data which makes it difficult to assess the cost-effectiveness of any these alternatives to acute hospital care.

As part of our systematic review, any relevant systematic review published in 2010-2016 was included and referred to when discussing the more recent studies. All of these reviews were on the topic of HaH interventions. In addition to being older evidence, some of the previous reviews in contrast to our own included a number of uncontrolled observational studies. Some also included studies in which HaH interventions were applied in the non-emergency or post-discharge settings. By contrast, our systematic review focuses on bringing together controlled studies on

alternatives to acute hospitalisation at the point of potential admission for the over 65s. The exception to the evidence of benefit of HaH is the treatment of stroke patients, who fare much worse with HaH intervention compared to treatment in a stroke unit. The authors of this study suggest that these differences are due to the overall expertise available in the stroke unit as opposed to care given by generic hospital or homecare staff advised by specialised stroke health professionals. It is recommended therefore that in most cases, in line with current NHS practice for stroke, care should to be provided in specialist units.[42]

In terms of health professionals, making a decision to admit an older patient can be difficult. Decision-making for different of patients draws upon a range of professional experience and expertise and should also be influenced by broader factors such as living conditions and individual/family/carer coping in addition to care preferences. If alternatives to acute admission are available, health professionals have to be confident about these alternative pathways for their patients.[5] Whilst many of the interventions in this review may provide viable alternatives to acute care, they may not exist in some healthcare communities or geographical regions. Furthermore, commissioners of health and social care services require comprehensive evidence of both effectiveness and cost effectiveness of any hospital alternatives as well as adequate resources in order to commission them.

Although our systematic review offered new evidence on several aspects of acute care provision for older patients, there are still many issues to take forward into future research. These include consideration of the wide range of interventions to be delivered, the variety of conditions to be treated, the generation of data to allow cost-comparisons with acute hospital admission, patient and family/carer acceptability,

health professional acceptability, and the commissioning and resourcing of new services.

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Competing interests

None of the authors have any competing interests to declare

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Lay representatives: Alma Brooks, Matt Pepper, Joan Pepper, Tom Doyle, and Liz Banks- Jones

Authors' contribution

ALH Lead systematic reviewer conducting all stages of the review and was responsible for the initial draft of paper.

MC Protocol of systematic review is based on outline from NIHR Programme Development Grant in which MC had a significant role. Specific expertise in Patient and Public Involvement. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

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AH Specific expertise in patient-related outcomes. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

WH Specific expertise in health economics. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

CM Specific expertise in trial design and statistical analysis. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

JB Professor of Emergency Care. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

SP Principal Investigator. Professor of Primary Health Care. Third reviewer of data. Commenting and editing on the drafts of the paper

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01.02.17

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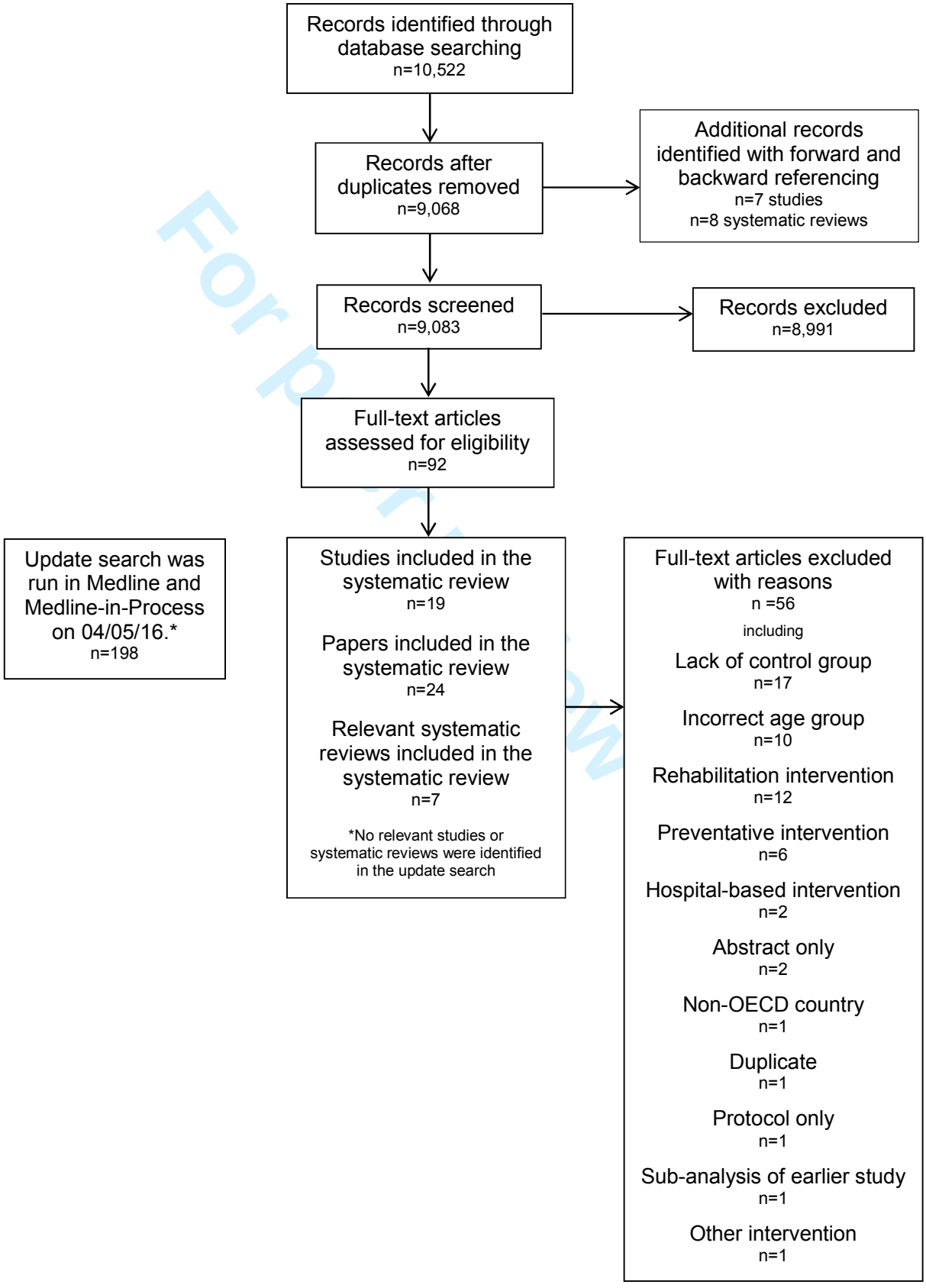
Figure 1 - PRISMA flow diagram searches



Appendix 1: Parent search strategy run in Medline

Database: Medline In-process - current week, Medline 1950 to present

Search Strategy: Run April 24th 2015

1 intervention?ti. or (intervention? adj6 (clinician? or collaborat$ or community or complex or DESIGN$ or doctor? or educational or family doctor? or family physician? or family practitioner? or financial or GP or general practice? or hospital? or impact? or improv$ or individuali?e? or individuali?ing or interdisciplin$ or multicomponent or multi-component or multidisciplin$ or multi-disciplin$ or multifacet$ or multi-facet$ or multimodal$ or multi-modal$ or personali?e? or personali?ing or pharmacies or pharmacist? or pharmacy or physician? or practitioner? or prescrib$ or prescription? or primary care or professional$ or provider? or regulatory or regulatory or tailor$ or target$ or team$ or usual care)).ab. (178760)

2 (pre-intervention? or preintervention? or "pre intervention?" or post-intervention? or postintervention? or "post intervention?").ti,ab. (11719)

3 (hospital$ or patient?).hw. and (study or studies or care or health$ or practitioner? or provider? or physician? or nurse? or nursing or doctor?).ti,hw. (747131)

4 demonstration project?.ti,ab. (2027)

5 (pre-post or "pre test$" or pretest$ or posttest$ or "post test$" or (pre adj5 post)).ti,ab. (72037)

6 (pre-workshop or post-workshop or (before adj3 workshop) or (after adj3 workshop)).ti,ab. (653)

7 trial.ti. or ((study adj3 aim?) or "our study").ab. (697929)

8 (before adj10 (after or during)).ti,ab. (375455)

9 ("quasi-experiment$" or quasiexperiment$ or "quasi random$" or quasirandom$ or "quasi control$" or quasicontrol$ or ((quasi$ or experimental) adj3 (method$ or study or trial or design$))).ti,ab,hw. (107858)

10 ("time series" adj2 interrupt$).ti,ab,hw. (1212)

11 (time points adj3 (over or multiple or three or four or five or six or seven or eight or nine or ten or eleven or twelve or month$ or hour? or day? or "more than")).ab. (10245)

12 pilot.ti. (43282)

13 Pilot projects/ (86631)

14 (clinical trial or controlled clinical trial or multicenter study).pt. (644558)

15 (multicentre or multicenter or multi-centre or multi-center).ti. (31588)

16 random$.ti,ab. or controlled.ti. (809402)

17 (control adj3 (area or cohort? or compare? or condition or design or group? or intervention? or participant? or study)).ab. not (controlled clinical trial or randomized controlled trial).pt. (440969)

18 Aged/ (2394306)

19 "Aged, 80 and over"/ (647729)

20 older adults.mp. (38411)

21 elderly adults.mp. (2417)

22 over 65 years.mp. (3421)

23 virtual ward.mp. (12)

24 intermediate care.mp. (1478)

25 Crisis response.mp. (103)

26 Crisis resolution.mp. (99)

27 reablement.mp. (12)

28 re-ablement.mp. (11)

29 hospital care at home.mp. (14)

30 hospital-at-home.mp. (289)

31 home hospital.mp. (150)

32 medical day hospital care.mp. (2)

33 day hospital.mp. (2435)

34 out-patient facility.mp. (13)

35 Domiciliary care.mp. (247)

36 intermediate services.mp. (7)

37 Intermediate Care Facilities/ (639)

38 Home Care Services, Hospital-Based/ (1662)

39 Home Health Nursing/ (58)

40 Home Nursing/ (8049)

41 admission avoidance.mp. (56)

42 outreach program.mp. (677)

43 hospital outreach.mp. (27)

44 nursing-led units.mp. (3)

45 hospital in home.mp. (8)

46 hospital in the home.mp. (123)

47 medical home care.mp. (39)

48 Crisis intervention service.mp. (31)

49 Geriatric emergency management practice model.mp. (1)

50 day unit.mp. (169)

51 Day Care/ (4670)

52 day centre.mp. (170)

53 comprehensive elderly care.mp. (2)

54 Substitutive care.mp. (1)

55 shared care.mp. (916)

56 guided care.mp. (69)

57 home-based versus hospital-based.mp. (11)

58 home hospitalisation.mp. (28)

59 rapid response team.mp. (515)

60 rapid response nurse.mp. (2)

61 Hospitals, Community/ (10479)

62 *Ambulatory Care/ (15963)

63 *Health Services for the Aged/ (12112)

64 or/1-17 (3278427)

65 or/23-63 (57831)

66 or/18-22 (2428347)

67 64 and 65 and 66 (11288)

68 67 not (child/ or infant/ or adolescent/ or maternal health services/) (9807)

69 68 not (case report/ or case study/ or letter/ or editorial/ or expert opinion.mp.) [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (9192)

70 69 not (Algeria$ or Egypt$ or Liby$ or Morocc$ or Tunisia$ or Western Sahara$ or Angola$ or Benin or Botswana$ or Burkina Faso or Burundi or Cameroon or Cape Verde or Central African Republic or Chad or Comoros or Congo or Djibouti or Eritrea or Ethiopia$ or Gabon or Gambia$ or Ghana or Guinea or Keny$ or Lesotho or Liberia or Madagasca$ or Malawi or Mali or Mauritania or Mauritius or Mayotte or Mozambiq$ or Namibia$ or Niger or Nigeria$ or Reunion or Rwand$ or Saint Helena or Senegal or Seychelles or Sierra Leone or Somalia or South Africa$ or Sudan or Swaziland or Tanzania or Togo or Ugand$ or Zambia$ or Zimbabw$ or China or Chinese or Hong Kong or Macao or Mongolia$ or Taiwan$ or Belarus or Moldov$ or Russia$ or Ukraine or Afghanistan or Armenia$ or Azerbaijan or Bahrain or Cyprus or Cypriot or Georgia$ or Iran$ or Iraq$ or Israel$ or Jordan$ or Kazakhstan or Kuwait or Kyrgyzstan or Leban$ or Oman or Pakistan$ or Palestin$ or Qatar or Saudi Arabia or Syria$ or Tajikistan or Turkmenistan or United Arab Emirates

or Uzbekistan or Yemen or Bangladesh$ or Bhutan or British Indian Ocean Territory or Brunei Darussalam or Cambodia$ or India$ or Indonesia$ or Lao or People's Democratic Republic or Malaysia$ or Maldives or Myanmar or Nepal or Philippin$ or Singapore or Sri Lanka or Thai$ or Timor Leste or Vietnam or Albania$ or Andorra or Bosnia$ or Herzegovina$ or Bulgaria$ or Croatia$ or Estonia or Faroe Islands or Greenland or Liechtenstein or Lithuani$ or Macedonia or Malta or maltese or Romania or Serbia$ or Montenegro or Slovenia or Svalbard or Argentina$ or Belize or Bolivia$ or Brazil$ or chile or Chilean or Colombia$ or Costa Rica$ or Cuba or Ecuador or El Salvador or French Guiana or Guatemala$ or Guyana or Haiti or Honduras or Jamaica$ or Nicaragua$ or Panama or Paraguay or Peru or Puerto Rico or Suriname or Uruguay or Venezuela or developing countr$ or south America$).ti,sh. (8719)

71 admission*.ab. (140603)

72 hospital*.ab. (747796)

73 71 or 72 (804011)

74 70 and 73 (3851)

75 limit 74 to yr="2005 -Current" (1880)

76 remove duplicates from 75 (1829)

Appendix 2: EPOC Risk of bias

Paramedic (PP) / emergency care practitioner (ECP) interventions

Study: Mason 2007 RCT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'We used cluster randomisation to reduce the risk of contamination (practice in the control group being influenced by the presence of the paramedic practitioner in the community) and to allow service level, rather than individual patient level, evaluation of the intervention. Weeks were randomised before the start of the study (to allow for rostering of the paramedic practitioners) to the paramedic practitioner service being active (intervention) or inactive (control), when the standard 999 service was available'
Was allocation adequately concealed?	Low risk	'Episode of care with some form of centralised randomisation scheme'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Flow of patients through trial was presented and intention-to-treat analysis used
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Majority of outcomes were objective but there was one about satisfaction with service i.e. subjective
Was study adequately protected against contamination?	Low risk	'We used cluster randomisation to reduce the risk of contamination (practice in the control group being influenced by the presence of the paramedic practitioner in the community) and to allow service level, rather than individual patient level, evaluation of the intervention'.
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Gray 2008 historical controls - older people with falls

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'From January to April 2006 inclusive, all the patients seen by the ECP service who had rung 999 with a diagnosis of either breathing difficulties or an elderly patient (.65 years of age) with a fall were reviewed.' 'Comparison data were taken from January to April 2005 inclusive for attendances to the same ED for patients with the same criteria as above seen by non-ECP ambulance service personnel'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	Unclear risk	No details given other than 'elderly patients >65yrs with a fall'
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were all objective
Was study adequately protected against contamination?	Low risk	Different data collection time-periods were reported for each group
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Only used half of the study population

Study: Mason 2012 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Potential 'intervention' trust sites were selected on the basis of their heterogeneity of service delivery of ECP care. 'Control' trust sites that did not employ ECPs, but were in close geographical proximity (i.e. within the same or in a neighbouring county) and which offered the same service configurations as the intervention trusts, were then selected'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	High risk	For the care home subgroup, figures were given on selected baseline characteristics but no formal comparison appeared to be made. On face value, clinical characteristics were not balanced e.g. adult medical 30 vs.41%, adult trauma 46 vs.13%
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were all objective
Was study adequately protected against contamination?	Low risk	Intervention and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Emergency Department (ED) interventions

Study: Sun 2014 RCT - syncope

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'Patients were block randomized (n=4) by site in a 1:1 ratio to either the observation protocol or routine inpatient admission'
Was allocation adequately concealed?	Low risk	'A computer generated the study arm assignment at randomization, and no research personnel had advance knowledge of study arm assignment. We could not blind this health service intervention to patients, providers, or research personnel.'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. inpatient admission rates
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Flow chart of participants provided and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were objective but one secondary outcome - participant satisfaction – was subjective
Was study adequately protected against contamination?	Unclear risk	Treatment and control were allocated and delivered in same location so possible for participants to swap allocation
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Salvi 2008 CT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Trained research assistant (VM) screened patients presenting to the ED for Monday to Friday from 9:00 a.m to 6:00 p.m using a standard information sheet explaining the study protocol to patients and proxies'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of initial admissions
Were baseline characteristics similar?	High risk	Intervention and control groups were unbalanced – age, 78.1(7) vs.82.5(7.2) p<0.001, female 47 vs. 68% p=0.004, married 70 vs. 40% p<0.001, SPMSQ 2.5(3.3) vs. 5.2(4.2) p<0.001, ADL4.3(2) vs. 3.2(2.5) p=0.001
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Unclear risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Benaiges 2014 CT - hyperglycaemia

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Patients were assigned to the DH group if they were admitted to hospital within DH opening hours (weekdays from 8:00 a.m to 4:00 p.m); otherwise they were treated in the emergency department and subsequently hospitalized'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of ER visits
Were baseline characteristics similar?	Low risk	Baseline characteristics of treatment and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	'Patients were treated with same protocol for both DH and CH' so contamination was possible
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Community hospital interventions

Study: Vicente 2014 RCT

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'The dispatchers at the EMCC randomized older adults into the study. A sealed envelope randomization procedure was initiated when the dispatcher received the incoming call and identified the participant as an individual aged 65 who resided in the specified geographical area and was assigned a priority level 2 or 3, and the call occurred between 8:00 a.m. and 10:00 p.m'
Was allocation adequately concealed?	Low risk	'The envelope contained the name of the EMS Company 1 or the name of the EMS Company 2. There was an equal chance (1:1) of being assigned to either of the ambulance companies'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of individuals sent direct to community hospital
Were baseline characteristics similar?	High risk	There was a difference in the priority level when ambulance sent out (% individuals) – Level 1) 1.6 vs. 0%, Level 2) 59 vs. 47%, Level 3) 39 vs.53%, p=0.001
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	Separate sealed envelope opened for each individual case
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Garasen 2007/8 ab RCT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'When an eligible patient was identified and accepted for inclusion, a blinded randomisation was performed by the Clinical Research Department using random number tables in blocks to ensure balanced groups'
Was allocation adequately concealed?	Low risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of readmissions for index disease
Were baseline characteristics similar?	Unclear risk	Baseline characteristics of intervention and control groups were described but no formal comparison reported
Were incomplete outcome data adequately addressed?	Unclear	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	Participants were allocated using a clear process but 8 individuals originally assigned to CH were later assigned to GH
Was study free from selective outcome reporting?	Low risk	All outcomes described in methods section were reported in results section plus 12-month data was used in Garasen 2008
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH) interventions: heart failure

Study: Patel 2008 pilot RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Open pilot RCT
Was allocation adequately concealed?	Unclear risk	Used 'random number generator under direction of specialist nurse or hospital admission staff' but no further detail provided
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since majority of outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and small differences seen in gender, education and two particular co-morbidities
Were incomplete outcome data adequately addressed?	High risk	Flow of patients was described although description of analysis was lacking
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Unclear risk	Difficult to understand the description of outcomes in methods section but all were reported in results section
Was study free from other risks of bias?	Unclear risk	Description of analysis and results was possibly too assertive for a feasibility study

Study: Mendoza 2009/Garcia-Soleto 2013 RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'Randomly assigned (1:1) to one of the intervention groups according to an externally generated sequence, which was hidden from the clinicians until the patient had given consent to participate'
Was allocation adequately concealed?	Low risk	As above
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but functional status and health-related QoL were similar
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was described and 'per protocol' analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Tibaldi 2009 RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'By the use of a set of computer-generated random numbers in a 1:1 ratio. The allocation sequence was unknown to any of the investigators and was contained in a set of sealed envelopes, each bearing on the outside only the name of the hospital and a number, which was opened after the acceptance of the patient'
Was allocation adequately concealed?	Low risk	Participants were enrolled within 12-24 hours of ED admission by research assistants, masked to both allocation and hypotheses being tested
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but depression, function and nutrition measures were similar
Were baseline characteristics similar?	Unclear risk	Baseline characteristics of intervention and control groups were reported and heart rate was significantly different p=0.006
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial described and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail available
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH): COPD

Study: Ricauda 2008 RCT - COPD

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Patients were randomised using a set of computer-generated random numbers in a 1:1 ratio.
Was allocation adequately concealed?	Low risk	Allocation sequence was unknown to any of the investigators and kept in a set of sealed envelopes, each bearing on the outside only the name of the hospital and a number. After acceptance of a patient, the ED nurse coordinator, who was not involved in the study, opened the appropriately numbered envelope
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but clinical outcomes e.g. depression were similar
Were baseline characteristics similar?	Low risk	Recorded in DE table
Were incomplete outcome data adequately addressed?	Low risk	Drop outs/loss-to-follow-up were recorded and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	Single-blind study since patients were aware of the treatment assignment although physicians and nurses evaluating patients were blinded to the patient's allocation
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH): Pulmonary embolism

Study: **Rodriguez-Cerillo 2009 nRCT - non-massive pulmonary embolism**

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	nRCT
Was allocation adequately concealed?	High risk	nRCT
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics of treatment and control groups were reported and only difference was prior thromboembolic disease, with these cases all being allocated to hospital
Were incomplete outcome data adequately addressed?	High risk	No patient flow or analysis was described
Was knowledge of allocated interventions adequately prevented during study?	High risk	nRCT
Was study adequately protected against contamination?	Low risk	Clinical decision-making at study entry and any subsequent changes were recorded – although none made in practice
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	High risk	Reported some 'external' decision-making

Hospital-at-Home (HAH): Pneumonia

Study: Carratala 2005 open RCT - pneumonia

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Randomisation was performed by using a computer-generated random code with a block size of 10
Was allocation adequately concealed?	Low risk	Randomisation was stratified by hospital site, and the random code was held centrally, in a sealed envelope, by the clinical epidemiologist. In the emergency department, the infectious disease consultant (in most cases not a study investigator) opened sealed, sequentially numbered opaque envelopes to randomly assign patients who had provided written informed consent and met the study criteria
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Detailed in DE table
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was reported and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	Trial was described as 'unblinded '
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Unclear risk	Lack of blinding in terms of assessment could be problematic

Hospital-at-Home (HAH): Stroke

Study: Kalra 2005 RCT - stroke

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Randomisation was not stratified and was undertaken using the block randomisation technique. This ensured that the number of patients allocated to the stroke unit or to domiciliary services at any one time did not exceed their capacity
Was allocation adequately concealed?	Unclear risk	Randomisation was conducted in blocks of 30 in an office remote from patient treatment areas, so that it would not be possible for those enrolling patients to guess allocation for the vast majority of subjects
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics with regard to stroke type, severity, level of impairment and initial disability were well-matched across the three groups
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was reported and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Unclear risk	Patients were brought to hospital from domiciliary care if that was considered to be clinically appropriate
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	High risk	In order to ensure that participants were treated in the most appropriate setting, swapping of groups was possible

Hospital-at-Home (HAH): Uncomplicated diverticulitis

Study: Rodriguez-Cerrillo 2013 nRCT - uncomplicated diverticulitis

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	nRCT
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Very limited details provided about age, gender and presenting complaint
Were incomplete outcome data adequately addressed?	High risk	No flow of patients was given and only basic analysis reported
Was knowledge of allocated interventions adequately prevented during study?	High risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Unclear risk	Both analysis and reporting of results were limited

Hospital-at-Home (HAH): Mixed population

Study: Leff 2005/2009 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'During the acute care hospital observation phase (1 November 1990 to 30 September 2001), eligible patients were identified and followed through usual hospital care.' During the intervention phase (1 November 2001 to 30 September 2002), eligible patients were identified at the time of admission and were offered the option of receiving their care in hospital-at-home rather than in the acute care hospital'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. time before evaluation
Were baseline characteristics similar?	High risk	Populations differed in measures of poverty, living alone and medication. This was acknowledged but not adjusted for.
Were incomplete outcome data adequately addressed?	Low risk	Intention-to-treat analysis was conducted although there were substantial missing data e.g. in relation to functional status
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective in Leff 2005 (main publication) but Leff 2009 used self-reported i.e. subjective daily activity of living as an outcome
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcomes described in methods section were reported in results section. Whilst there is no mention of activities of daily living in Leff 2005, this outcome was reported in Leff 2009
Was study free from other risks of bias?	Unclear risk	Possible selection bias related to differences in baseline characteristics e.g. functional status

Study: Lau 2003 historical controls

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	Control trial with historical control group
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. palliative care received
Were baseline characteristics similar?	High risk?	There was an imbalance in patient characteristics which may have been due to recruitment bias since the provider was responsible for recruiting patients into the trial. There were more dementia patients treated outside of hospital – although presumably their symptoms were 'fairly mild' since more pronounced behavioural problems were excluded from HaH group
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study name: Crilly 2010 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	Intervention group included 62 Aged Care Facility (ACF) residents who were enrolled in the Hospital in Nursing home programme during the first 12 months that the programme was operational, from 1 July 2003–30 June 2004. All sample members were ACF residents who presented to the ED and were subsequently admitted to hospital
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. palliative care received
Were baseline characteristics similar?	Low risk	Baseline characteristics of the study and control are reported and similar
Were incomplete outcome data adequately addressed?	Unclear	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Appendix 3: AMSTAR ratings of systematic reviews

Study	Was an 'a priori' design provided?	Was there duplicate study selection and data extraction?	Was a comprehensive literature search performed?	Was the status of publication (i.e. grey literature) used as an inclusion criterion?	Was a list of studies (included and excluded) provided?	Were the characteristics of the included studies provided?	Was the scientific quality of the included studies assessed and documented?	Was the scientific quality of the included studies used appropriately in formulating conclusions?	Were the methods used to combine the findings of studies appropriate?	Was the likelihood of publication bias assessed?	Was the conflict of interest included?
Caplan 2012	YES	YES	YES	YES	NO excluded studies not listed	NO studies were grouped by medical, surgical, rehabilitation and psychiatric	YES	YES	YES	YES	YES
Chalmers 2011	YES	YES	YES	NO	NO excluded studies not listed	YES but no ages and no direct reporting of participants in either group	YES but not detailed and whilst Cochrane was cited only one RCT involved	YES	UNCLEAR difficult to judge whether combination of study types is commonly accepted	No	YES
Jeppensen 2012 (Cochrane)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Qaddoura 2015	YES	YES	YES	YES	NO excluded studies not listed	YES	YES	NO relatively high risk of bias but all available data used	NO meta-analysis of two RCTs plus combination of different QoL measures from same study in meta-analysis	NO	YES
Shepperd 2016 (Cochrane)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Varney 2014	YES	NO used single reviewer	YES	YES	NO	YES	YES	NO	N/A no data were combined	NO	YES
Vinson 2012	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Appendix 4: description of interventions included in systematic review

Intervention	Description
Paramedic practitioner (PP) / emergency care practitioner (ECP) interventions	PPs/ECPs can be trained to 'assess and treat' or to refer patients with a range of conditions, as part of pre-hospital care. These roles were created in order to provide a more appropriate response to patients needs in emergency and urgent care settings. Their main purpose is to improve the pathway of care and patient experience, particularly by discharging patients at the scene or by referring on to the most appropriate care practitioner, reducing unnecessary emergency department (ED) attendance and avoidable admissions.
Community hospital (CH) interventions	The role of CHs varies between country and health systems but, essentially, their main role is to provide non-urgent i.e. routine or rehabilitative care. However, their role can be extended to provide an alternative to acute hospital (AH) admission for appropriate cases.
Emergency department (ED) interventions	These involve initial assessment in the ED, followed by an extended stay for tests and observation. This extended stay is in a bed closely associated with the ED, if not part of it.
Hospital-at-home (HaH) interventions	HaH services provide acute or sub-acute treatment in a patient's residence for a condition that would normally require admission to hospital. It is also known as 'hospital in the home' and 'home hospitalisation'.
Hospital in nursing/care home (HNCH) interventions	HNCH is as a model of admission avoidance to treat patients living in nursing and residential care homes, working on the same principles as HaH for community-dwelling residents.

Appendix 6: Characteristics of those older patients for whom the decision to admit to hospital may be unclear

Patient characteristics	Studies which include such populations
Age ≥75 years for included patients	15/19 studies Mason 2007 & 2012; Benaiges 2014; Salvi 2008; Garasen 2007; Vincente 2014; Patel 2008; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Kalra 2005; Rodriguez-Cerillo 2013; Leff 2005; Crilly 2010; Lau 2013
Co/multi-morbidities in included patients stated either by number of conditions or multi-morbidity score e.g. Charlson Score	9/19 studies Benaiges 2014; Salvi 2008; Patel 2008; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Carratala 2005; Leff 2005; Lau 2013
Dementia either stated in a) patient demographics or b) used as an exclusion criterion based on severity	a) 2/19 studies Rodriguez-Cerillo 2009; Lau 2013 b) 8/19 studies Mason 2007; Sun 2014; Salvi 2008; Garasen 2007; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Lau 2013
Social care support stated in inclusion/exclusion criteria	3/19 studies Tibaldi 2009; Ricauda 2008; Kalra 2005;
Home situation stated in inclusion/exclusion criteria	7/19 studies Benaiges 2014; Garasen 2007; Mendoza 2009; Ricauda 2008; Rodriguez-Cerillo 2009, 2013; Lau 2013
Individual coping abilities stated in inclusion/exclusion criteria	2/19 studies Patel 2008; Rodriguez-Cerillo 2013

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NHS
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Health Research

PROSPERO International prospective register of systematic reviews

A systematic review to identify and assess the effectiveness of hospital alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission

Alyson Huntley, Melanie Chalder, Will Hollingworth, Chris Metcalfe, Ben Davies, Sarah Purdy

Citation

Alyson Huntley, Melanie Chalder, Will Hollingworth, Chris Metcalfe, Ben Davies, Sarah Purdy. A systematic review to identify and assess the effectiveness of hospital alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission. PROSPERO 2015:CRD42015020371 Available from http://www.crd.york.ac.uk/PROSPERO_REBRANDING/display_record.asp?ID=CRD42015020371

Review question(s)

1) What admission alternatives are there for older patients and do they improve patient outcomes e.g. mortality, quality of life?

2) What are the defining characteristics of those older patients for whom the decision to admit to hospital may be unclear?

Searches

MEDLINE, MEDLINE in process, EMBASE, CINAHL and the Cochrane Central Register of Controlled Trials (CENTRAL) from 2005 to April 24th 2015. The Kings Fund and AHRQ websites were also searched

Types of study to be included

Any type of controlled study

Condition or domain being studied

Any condition that may result in an avoidable hospital admission in patients over the age of 65.

Participants/ population

People over 65 years of age of either sex living in OECD countries who are at risk of an unplanned admission (probably for an ambulatory sensitive condition) - they will therefore not be admitted to hospital at time of recruitment but could be in community or emergency department (being assessed).

Intervention(s), exposure(s)

The intervention of interest is admission to hospital, using definitions developed for previous studies (Huntley et al, Family Practice Fam Pract. 2013 Jun;30(3):266-75.). However it is important to point out that admission is likely to be the control group in many relevant studies.

Comparator(s)/ control

Alternatives to admission (likely to be described as the intervention) including but not limited to: hospital at home, virtual ward, rapid response nursing, care at home, admission to a care home, usual care.

Context

Reducing emergency bed days is one of the biggest challenges currently facing the National Health Service (NHS). There is considerable pressure to reduce hospital admissions amongst older people (D'Souza, BMJ 2013). There has been a 65% increase in hospital admissions for those over 75 years of age in the last decade ,and the oldest old, those over 85 years , now account for 11% of emergency admissions and 25% of bed days (NHS England 2013). There are some older people for whom care in the community is safe,perhaps with the provision of additional services and some for whom admission is required in order to deliver diagnostic or treatment techniques that are only available as an in patient. This review seeks to identify interventions for those patients that do not fall neatly into one of these categories and in doing so will assess the efficacy of the interventions and provide more detail on this patient

population.

Outcome(s)

Primary outcomes

1) Patient outcomes (including mortality, quality of life, length of stay, readmission, adverse effects of intervention) plus costs if available.

2) Patient characteristics for whom their pathway (admission or not) is unclear including risk factors e.g. co-morbidities (mental & physical), age, gender, social circumstances ,disease severity, recent admission/discharge availability of other services

Secondary outcomes

None

Data extraction, (selection and coding)

Standardised data extraction forms will be developed using existing guidelines (Higgins 2008 Cochrane handbook chapter 7 section 7.5). Data will be abstracted by one reviewer. A second reviewer will check data abstraction against the original paper. Data items: details on participants, Interventions, comparisons,outcome measures

Risk of bias (quality) assessment

Cochrane risk of bias tool will be used for randomised controlled trials. CASP criteria will be used for controlled trials

Strategy for data synthesis

Meta-analysis of data will be performed using Review Manager Version 5.1 if there are at least three trials with combinable data with a fixed or random effects model depending on the level of between trial heterogeneity estimated using the I-squared statistic. Sensitivity analysis will be performed as the data dictates.

Analysis of subgroups or subsets

Dependent on data found

Dissemination plans

This review is part of programme development grant.

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Details of any existing review of the same topic by the same authors
None

Anticipated or actual start date
02 February 2015

Anticipated completion date
29 January 2016

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NIHR Programme Development Grant RP-DG-1213-10004

Conflicts of interest
None known

Language
English

Country
England

Subject index terms status
Subject indexing assigned by CRD

Subject index terms
Hospitalization; Hospitals; Humans

Stage of review
Ongoing

Date of registration in PROSPERO
14 May 2015

Date of publication of this revision
14 May 2015

DOI
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Stage of review at time of this submission	Started	Completed
Preliminary searches	No	Yes
Piloting of the study selection process	No	Yes
Formal screening of search results against eligibility criteria	Yes	No

Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Pages 2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Page 5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Pages 5-6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Page 6
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Page 6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Pages 6-7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Page 7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Page 7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Page 8

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Page 7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Page 8 and Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Pages 8-17
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Pages 8-17 and Appendices 2 & 3
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Pages 8-17 and Appendix 5
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Pages 8-17 plus narrative presentation
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Pages 8-17
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Page 18
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Pages 18-19
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Page 19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Page 21

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

PRISMA 2009 Checklist

Appendix 5 : Detail of included studies

Paramedic/ECP) interventions (n=3)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Mason **2007** **UK**	**Cluster RCT by service** **56 clusters** **Intervention:** paramedic practitioner service n=1469 **Control:** Inactive paramedic practitioner service n=1549	**Inclusion criteria:** Patients aged ≥60yrs recruited from 1 Sep 2003- 26 Sep 2004. Call originated from a Sheffield postcode between 8am-8pm, with a presenting complaint that fell within the scope of practice of the paramedic practitioners. **Exclusion criteria:** **None given** 'If patients were unable to complete questionnaires e.g. because of cognitive impairment or who were unable to read English—we obtained consent for follow-up by review of clinical records only. **Baseline characteristics of participants** Intervention vs. control **Mean age (SD)** 82.6(8.3) vs. 82.5(8.3) yrs **Women %** 72 vs.73% **Living in on own home %** 78vs.78 % **Presenting complaint %** Fall 88 vs.89% Haemorrhage 6 vs.5% Acute medical condition 6vs.5%	A paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner. All identified patients were approached face to face either in the community or in ED for written consent to follow-up. Patients who had more than one eligible episode were recruited only once. The research team independently checked the ambulance service call database at the end of each month for any additional eligible calls not identified These were checked for selection bias but not followed up. Scope of practice of paramedic practitioners: Falls, Lacerations, Epistaxis, Minor burns, Foreign body in ear, nose, or throat, Local anaesthetic techniques, Wound care and suturing techniques, Principles of dressings and splintage, Joint examination, Examination of neurological, cardiovascular, and respiratory system, Examination of ear, nose, and throat, Protocol led dispensing: simple analgesia, antibiotics, tetanus toxoid, Assessment of mobility and social needs, Additional options for referral and requesting investigations, Requests for radiography, Referral processes: emergency department, general practitioner, district nurse, community social services	A paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner in the ED Procedure continued as for intervention	**Relevant measures & outcomes** Primary outcomes ***ED attendance*** ***Hospital admissions within 28 days*** ***Time of call to time of discharge*** ***Patient satisfaction survey including the EQ-5D*** Secondary outcomes ***Subsequent unplanned contact with secondary care at 28 days*** ***Mortality at 28 days***	Intervention vs. control Primary outcomes ***ED attendance (28 days)*** **970 (62.6%) vs. 1286 (87.5%)** **p<0.001** ***Hospital admissions (28 days)*** **626 (40.4%) vs. 683 (46.5%)** **p<0.001** ***Mean Time of call (SD) to time of discharge in mins*** **235.1(183.3) vs. 277.8(182.6)** **p<0.001** ***Patient satisfaction survey including the EQ-5D*** **Very satisfied with care 656 (85.5%)vs.528 (73.8%)** **p<0.001** Secondary outcomes ***Subsequent unplanned contact with secondary care*** **330(21.3%) vs. 259 (17.6%)** **p<0.01** ***Mortality at 28days*** 68(4.4%) vs.74(5%) p=0.41

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Gray **2008** **UK**	**COS with historical controls** **Intervention:** Emergency care practitioner **(ECP)** intervention n=233 **Control:** Historical control group from ED n=772	The study included two groups of patients a) those with breathing difficulties & b) elderly patients >65yrs with a fall. The latter only is reported here. **Inclusion criteria:** Elderly patients >65yrs with a fall. **Exclusion criteria:** None given **Baseline characteristics of participants** None given	**Outline of intervention** Jan-April 2006 inclusive, all the patients seen by the ECP service who had rung 999 and were an elderly patient (>65yrs) with a fall were reviewed. Each patient seen by an ECP was searched for in the hospital records for ED attendance or admissions in 72 h and 28 days following attendance by an ECP	**Outline of control** Comparison data taken Jan- April 2005 inclusive for attendances to same ED for patients with the same criteria as above & seen by non-ECP ambulance service personnel. These dates were chosen because, during this time, the ECP service was not tasked to patients with breathing difficulties and Yorkshire Ambulance Service had only 12 operational ECPs during this comparison period compared with 24 whole-time equivalent operational ECPs during the study period	**Relevant measures & outcomes** Outcome on initial contact: ***Treated at and stayed home*** ***ED and or admitted*** At 72hrs & 28 days ***At home*** ***ED attendance*** ***Admission*** **Costs** None	**ECP vs. ED** Outcome on initial contact: ***Stayed at home (PC referral)/went home*** 171 vs. 369 (73% vs. 48% avoidable admission rate) **At 72hr:** 21/171 (intervention grp) attended ED and or were admitted **At 28 days:** A further 19 (intervention grp) attended ED and or were admitted Avoidable admission rate (intervention grp) at 28 days was 56% (17% better) compared to control group p<0.05

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Mason **2012** **UK**	**COS** **Intervention:** Five teams of Emergency Care Practitioners (ECP) n= 256 for care home cohort **Control:** Five usual care providers n=201 for care home cohort	**Inclusion criteria:** Informed consent was obtained from all study participants prior to recruitment. Within each pair of services all patients presenting with emergency or urgent complaints that were eligible to be seen by ECPs and presented to either the intervention or the control services between May 2006 and August 2007 were included in the trial. **Exclusion criteria:** No detail **Baseline characteristics of participants** (no stats given) Care home cohort Intervention vs. control **Mean age** 83.5(10.40 vs. 84.5(8.5) yrs **% Female** 68 vs.66% **Clinical complaint %** Adult medical 30 vs.41 % Adult trauma 46 vs.13 % Elderly falls 23vs.46%	**Outline of intervention** No detail	**Outline of control** No detail	**Relevant measures & outcomes** Using paired services Primary outcomes ***% of patients Discharged following consultation with no further follow up by any health professional*** ***Urgently referred to hospital (both ED or direct admission)*** ***Non-urgently referred to GP or community care*** Secondary outcomes (relevant ones only) ***Episode time from first contact to discharge***	***Discharged with no further follow up by any health professional*** 49.2 vs.12.4% MD 36.8% (95% CI 26.7,46.8) ***Urgently referred to hospital (both ED or direct admission)*** 22.7 vs. 87.6% MD -64.9% (95% CI -71.8 ,-58.0) ***Non-urgently referred to GP or community care*** 28.1vs. 0% 28.1% (22.6,33.7) ***Episode time from first contact to discharge median in mins (IQR)*** 60 (40,80) vs. 39 (29,58) Time ratio 1.36 (1.24,1.49)

ED Interventions (n=3)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Sun **2014** **USA**	**RCT** **Intervention:** ED observation syncope protocol n=62 **Control:** Normal In-patient admission n=62	**Inclusion criteria:** Patients aged≥ 50 years or older diagnosed with intermediate syncope. **Exclusion criteria** Patients with a serious condition: symptomatic arrhythmias, myocardial infarction, pulmonary embolism, acute pulmonary edema, stroke, severe anaemia or blood loss requiring blood transfusion, sepsis, and major traumatic injury. Also: seizure, head trauma, or intoxication as reason for loss of consciousness; new/ baseline cognitive impairment; do-not-resuscitate or do-not-intubate status; active chemotherapy and inability to speak either English/Spanish. Met high risk criteria. **Baseline characteristics of participants** Observation vs. control Mean(SD) or% **Mean age** 65 (11) vs. 64(11) **% Female** 53 vs. 48 **Syncope index complaint (vs near syncope)** 74vs. 61% **Congestive heart failure** 2vs. 3% **Coronary artery disease** 13vs.8% **Arrhythmia** 8vs.6% **Syncope in previous yr** 16vs.21% **Quality of well-being scale** 0.55(0.15) vs. 0.55(0.14) **Syncope functional status** 29((25) vs.25(26) **Syncope risk score** 0.76 (0.840 vs.0.76 (0.67)	**Outline of intervention** Patients received continuous cardiac monitoring ≥ 12hrs. ≤2 serial cardiac troponin tests approx. 6 hours apart to exclude acute MI. Rest echocardiogram for patients with cardiac murmur, if not performed in previous 6mths. Additional testing as required. Maximum stay in observation unit could not be more than 24hrs. Observation protocol patients who received a diagnosis detailed in exclusion list or had pending tests at 24hrs were admitted **High Risk Criteria** Serious condition identified in the ED, History of ventricular arrhythmia, Cardiac device with dysfunction, Exertional syncope, Presentation concerning for acute coronary syndrome, Severe cardiac valve disease (e.g., aortic stenosis <1 cm2), Known cardiac ejection faction <40% Electrocardiogram findings of QTc>500 mS,pre-excitation, non-sustained ventricular tachycardia, Emergency physician judgment **Intermediate Risk Criteria** No high risk features **AND** No low risk features **AND** Clinical judgment by emergency physician that patient requires further diagnostic evaluation **Low Risk** Symptoms consistent with orthostatic or vasovagal syncope**,** Emergency physician judgment that no further diagnostic evaluation is needed.	**Outline of control** The syncope protocol was not used. Contamination between groups was minimized by being managed in distinct physical spaces by different clinical services. **Intervention delivered by:** No detail	**Relevant measures & outcomes** Primary outcomes ***Inpatient admission rates*** ***Hospital LOS at indexed visit*** Secondary outcomes ***30 day and 6mth serious events*** ***Index and 30 day hospital costs*** ***30 days changes in QoL*** ***30 day patient satisfaction***	***Observation vs. s care*** ***Inpatient admission rates*** **9 (15%) vs. 57 (92%)** **Relative rate 0.16 (95%CI 0.09,0.29, p<0.001)** ***Hospital LOS at indexed visit*** **mean SD (hrs) 29 (15) vs. 47hrs (34) (p<0.001)** ***Serious events*** ***During hospital visit*** Death 0 vs. 0 Arrhythmia 2 vs. 2 Pacemaker insertion 1vs.1 Syncope with bone fracture 2 vs.1 30 days recurrent syncope 1 vs 1 30 day serious outcomes after discharge 2 vs. 0 6mth serious outcomes after hospital discharge 4 vs.5 ***Costs $ (SD)*** At index visit 1,400(1,220) vs.2,420(3,930) Within 30 days 1,800(2,150) vs.2,520(3,980) ***Change in quality of life*** mean SD 0 (0.2) vs. 0.03 (0.18) ***Change in syncope functional status*** -7.6(20.1) vs.-2.4(26.3) ***Patient satisfaction*** 8.9(1.40 vs.9.3(0.9)

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Benaiges **2014** **Spain**	**COS** **Intervention:** 'Day hospital' (DH) n=64 **Control:** Conventional hospitalisation (CH) n=36	**Inclusion criteria:** Patients with sustained hyperglycemia (>300 mg/dL) for at least 3 days with or without ketosis **Exclusion criteria** Ketoacidosis (venous pH <7.31 and/or HCO3 <22 mEq), hyperosmolar crisis (glycemia >600 mg/dL and effective plasma osmolarity >320 mOsm/L), unstable hemodynamic status or need for ventilatory support, severe precipitating factors such as acute myocardial infarction, stroke, sepsis, social deprivation, and dependence for four or more activities of daily living (Katz index >D). **Baseline characteristics of participants (Stats shown if signif)** DH vs.CH **Age** 80.3(4.8)vs. 80.6(4.6)yrs **Female** 67 vs. 56% **BMI** 26.1(4.9)vs.25.5(5.1) **Katz A&B** 72.2vs.72.2% **Charlson Index** 3.2(2.0)vs. 3.3(1.7) **Family support** 88.1 vs.97.1% **Diabetes duration** 14.4 (8.0) vs. 97.1 yrs Plus other specific diabetes measures	**Outline of intervention** Patients assigned to DH if admitted to hospital within DH opening hours (week days 8 am -4 pm); otherwise they were treated in ED and subsequently hospitalized. After initial treatment of hyperglycemic crisis DH patients were scheduled for follow-up visits at 24, 72 hours, and 7 days to adjust treatment and to complete their diabetes education Patients were treated with same protocol for both DH and CH: this included initial evaluation with a blood test, urinalysis, chest radiograph to rule out underlying infectious disease, and hourly measurement of glycemia and ketonemia. Treatment included hydration as required, an insulin regimen with insulin, and oral carbohydrate intake if glucose levels were less than 250 mg/dL with persistent ketosis. If infection was diagnosed, treatment was initiated. Diabetes education was delivered by specialist diabetes nurse with specific attention paid to dietary advice, physical activity, and recognition of hypoglycemia. Measurement of glycated hemoglobin (HbA1c) and clinical evaluation was scheduled for 3 & 6 mths for patients in both groups	**Outline of control** At hospital discharge, CH patients were scheduled for a one-week follow-up visit in outpatient clinic. **Intervention delivered by:** Unclear but normal outpatient staff	**Relevant measures & outcomes** (no distinguishing between primary and secondary outcomes) At 3 mth follow up ***[No. of mild or severe hypoglycemic episodes]*** ***Readmissions for diabetes or unrelated cause*** ***[Nosocomial complications]*** ***No. of outpatient visits*** ***No. of ER visits*** [outcomes] not detailed as not relevant to our question ***Costs*** ***Initial care*** ***Complementary examinations*** ***Pharmacy*** ***Outpatient visits*** ***Readmissions*** ***Total*** In euros	Mean (SD) DH vs.CH **Readmissions for diabetes (%)** **1(1.6)vs. 5 (13.9)** **P=0.04** Readmission for any cause (%) 4(6.3)vs.7(19.4) p=0.085 **No. of outpatient visits (SE?)** **5.0(2.2)vs. 2.5(2.0)** **p=0.012** No. of ER visits (SE?)? 0.2(0.6)vs.0.2(0.4) P=0.59 **Costs** **Initial care** **580.2(489.1) vs. 2,013.6(790.4) p<0.001** **Complementary examinations** **123.7(276.3) vs. 281.3(188.1) p=0.007** Pharmacy 12.8(95.6)vs. 20.3(24.8) P=0.676 Outpatient visits **116.7(75.3) vs. 56.9(105.7) p=0.003** **Readmissions (total)** **340.8(1190)vs.288.3(916.8)p=0.835** **Total** **1,345.1(793.6) vs. 2,212.4(982.5) p<0.001**

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Salvi **2008** **Italy**	**COS** **(secondary analysis)** **Intervention:** Geriatric ED (GED) n=100 **Control:** Conventional ED (CED) n=100	**Inclusion criteria:** Patients aged ≥ 65yrs were enrolled in June 2006 from the GED and July 2006 from the CED taking care that none presenting to the ED in the course of the study period was recruited again. **Exclusion criteria** Cognitive impairment (a score of ≥5 on the Short Portable Mental Status Questionnaire SPMSQ) and no proxy, Those too ill to respond, Trauma patients **Baseline characteristics of participants** CED vs GED Mean(SD) **Age 78.1(7) vs.82.5(7.20 p<0.001** **Female 47 vs. 68% p<0.001** **Married 70 vs. 40% p<0.001** Living alone 12 vs 14 **Triage code** Urgent/semi-urgent (2/3) 97 vs.90 % Charlson Index 3.3(2.3) vs. 3.4(1.7) **SPMSQ** **2.5(3.3) vs. 5.2(4.2) p<0.001** **ADL4.3(2) vs. 3.2(2.5)** **P=0.001** No differences in profile of diagnosis in ED between groups	**Outline of intervention** No details beyond ED plus observation unit of 6 beds **Intervention delivered by:** No details	**Outline of control** Patients presenting to ED were screened Mon-Fri 9am- 6pm using standard information sheet. Interviews conducted with patients or family member/other for patients with cognitive impairment. Written consent & access to medical records was obtained. patients a underwent a brief geriatric assessment using the Charlson Index, SPMSQ, and ADL before the current event	**Relevant measures & outcomes** ***Mean duration (SD)*** ***No. of initial admissions*** ***LOS in hospital days*** ***Both of above presented as baseline data*** ***No. ED visits at 30 days and 6 mths*** ***Frequent ED return (≥3 visits over 6 mths)*** ***No. hospital admissions at 6mths*** ***ADL at 6mths (defined as functional decline*** ***Mortality at 30 days & 6 mths*** **Costs** None	CED vs. GED ***Mean duration (SD)*** **6.2(4.5) hrs vs. 12.8 (8.5) hrs** **P<0.001** ***No. of initial admissions*** 53 vs.63 p=0.2 ***LOS in days*** 10(6.65) vs. 10.5(7.2) p=0.74 ***No. ED visits*** 30 days 25 vs. 23 visits p=0.88 6months 51 vs. 42 p=0.25 ***Frequent ED return (≥3 visits over 6 mths)*** 11 vs.13 visits p=0.84 ***No. hospital admissions at 6mths*** 36 vs.29 p=0.2 ***ADL*** 20 vs. 20 p=0.34 ***Mortality*** **30 days 8 vs. 5 deaths** **6months 20 vs. 19** Statistically significant at 6mths after adjustment for age, sex, living status, admission at time of recruitment Charlson index, SPMSQ and ADL **p=0.047**

Community hospital (n=2)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Garåsen **2007/8ab** **Norway**	**RCT** **Intervention:** Community hospital (CH) n=72 assigned but 8 went on to GH **Control:** General hospital (GH)admission n=70	**Inclusion criteria:** Patients aged ≥60 years admitted to general hospital due to acute illness or acute exacerbation of known chronic disease Probably in need of in ward care for ≥ 3-4 days Admitted from own homes and expected to return home when care finished. **Exclusion criteria** Severe dementia or a psychiatric disorders needing specialised care 24 hours a day. **Baseline characteristics of participants** **(No stats given)** [including data from n=8 who were assigned CH then went to GH] CH vs.GH **Age** 80.6 (0.8)vs. 81.3(0.8)yrs **Female** 72 vs.61% **Living with spouse** 16 vs. 15 **ADL (SD)** 2.24(0.9) vs. 2.05 (0.7) **Primary diagnosis** **Cardio dis** 31 vs.29% **Infect** 18vs. 23% **Fractures/contusions** 19vs. 17% **Pulmonary disease** 7vs.9% **Neurological** 7 vs.6% **Cancer** 3 vs 6% **Psychiatric** 1vs.0% **Other** 14 vs 11%	**Outline of intervention** On admission to CH the physicians performed a medical examination of the patients and a careful evaluation of available earlier health records from the **admitting general practitioner, the general hospital physicians and the community home care services**. The communication with each patient and his family focusing on physical and mental challenges was also essential to understand the needs and level of care. . Assume from the inclusion criteria that all patients came to the general hospital initially then ' When an eligible patient was identified and accepted for inclusion, a blinded randomisation was performed by the Clinical Research Department at the Faculty of Medicine.' All patients randomised for care at the community hospital were transferred from the general hospital within 24 hours after the time of inclusion to the study and immediately after the time of randomisation.	**Outline of control** The care at different departments at GH and communication with primary health care followed the standard routines through the formal organisation.	**Relevant measures & outcomes** Follow up at 26 weeks & 12 months ***No. of readmission for index disease*** ***Need for community home care*** ***Need for long term nursing home*** ***No. of days in institutions after randomisation [intervention +rehab +readmissions] data is available for separate services*** ***No. of deaths*** ***No. of days before death*** ***No care*** 12 month data in [0273] **Costs** None	CH vs. GH No. (%) At 26 weeks ***No. of readmission for index disease*** **14(19%) vs. 25 (36%) p=0.02** ***Need for community home care*** 38(53%) vs. 44(63%) p=0.37 ***Need for long term nursing home*** 7(10%) vs. 5(7%) p= 0.76 ***No. days in institutions*** 31(95% CI 26.1,34.7) vs.29.8 (95% CI 23.2,36.4) p=0.80 ***No. of deaths*** 9(12.5%) vs14(20%) p=0.15 **No. days before death** 165 (95% CI 154-176) vs. 156 (95% CI 144,165) **No care** **18(25%) vs. 7(10%) p=0.01** 12 month data **No. of deaths** **13(18.1%) vs. 22 (31.4%) p=0.03** **Total observation period** **335.7(95% CI 312.0,359.4) vs. 292.8(95%CI 264.1,321.5) days p=0.01**

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Vicente 2014 **Sweden**	**RCT** **Intervention:** Going to a community-based hospital n=410 **Control:** Going to ED n=396 .	**Inclusion criteria:** No specific information **Exclusion criteria:** No specific information older adults were randomized when they called the emergency number **Baseline characteristics of participants** Intervention vs. control **Mean age (SD)** 81 (8) vs. 81(8) yrs **% Female** 56 vs. 59% **Priority level when ambulance sent out (% individuals)** **1. 1.6 vs. 0%** **2. 59 vs. 47 %** **3. 39 vs.53%** **P=0.001** **Priority level when ambulance arrives at hospital (% individuals)** 1. 7.2 vs.3.6% 2. 39 vs.35% 3.54 vs.61%	**Outline of intervention** The study was conducted over 14 months from Oct 2008 to Dec 2009. Two EMS companies were included in the study. Ambulance personnel at Company 1 had training in and access to the system and tool and could triage eligible individuals to a GW or, a CECC at a CH. By following system and tool & after assessment of the individual's medical situation and care needs, the ambulance nurse was able to decide whether the individual required full ED services or would benefit more from being transported to an assessment at the CH instead. **Delivered by:** The ambulance nurse education are required to have a course of 60 credits includes ≥ 30 credits in Caring Science. The criterion for entering this program is a BSc Caring Science and Nursing. Since 2007, a 1-year Master's Degree & postgraduate Diploma in Specialist Nursing, Prehospital Emergency Care Program has been available.	**Outline of control** Ambulance personnel at Company 2 had no training in the system and tool, and transported all individuals to a full-service ED at a tertiary hospital	**Relevant measures & outcomes** Primary outcome: ***No. of individuals sent direct to CH for either to GW or CECC*** *Secondary outcome:* ***No. of subsequent transfers from CH to ED within 24 hrs*** Calculated as Intention to treat (ITT) and per protocol (pp) analysis **Costs** None	Intervention vs. control ***No. of individuals sent direct to CH for either to GW or CECC*** ITT 90/449 20% (16.6,24) PP 56/273 20.5% (16.1,25.7) ***No. of subsequent transfers from CH to ED within 24 hrs*** ITT 6/90 6.7% (3.1,13.8) PP 4/56 7.1 (2.8,17.0)

Hospital at home for community dwelling older people (n=9)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Patel 2008 **Sweden** **Heart Failure**	**pilot RCT** **Intervention:** HC Treated at home after >48hrs treatment in ED (n=13) **Control:** CC Treated in hospital as per hospital treatment guidelines (n=18)	**Inclusion criteria:** *Into study* Earlier diagnosed with CHF with diastolic or systolic LVD Deterioration of HF ≥3 days with symptoms of increasing dyspnoea, orthopnoea, weight gain≥2 kg, debuting peripheral oedema or abdominal swelling Clinical signs, e.g., extended jugular vein, leg oedema, tachypnoea, pulmonary rales, ascites and third heart sound. At least one symptom and one sign should be present New York Heart Association class II–IV *for home treatment* It was considered medically safe to treat patients at home if they had a S-Potassium level 3.4-5.5 mmol/L, systolic blood pressure >95 mm Hg, S Creatinine<250 µmol/L & <50% increase from the baseline value during drug adjustment. **Exclusion criteria** Unwillingness to participate Worsening of CHF<3 days Newly onset HF, Pulmonary or pre-pulmonary oedema, Need for monitoring of arrhythmia Other morbidities indicating need for hospitalisation. Living at an institution. Inability to follow instructionsS-Haemoglobinb100 g/L or a decrease of S Haemoglobin>20 g/L S-Creatinine>250 µmol/L S-Potassium>5.5 mmol/L or b3.4 mmol/L S-Troponin T>0.05 µg/L Creatine kinase-MB>5 µg/L ASAT and ALAT>three times above the normal value. Systolic blood pressure>95 mm Hg Heart rate<45 or >110 beats/min **Baseline characteristics of participants** Male n (%) 6 (46)/7 (54) 15 (83)/3 (17) 0.03 Age (years) mean (SD) 77 (10) 78 (8) ns Marital status n (%) Divorced 2 (15) 3 (17) ns Single 1 (8) 2 (11) ns Widowed 7 (54) 5 (28) ns Education n (%) ≥9 years 1 (8) 8 (44) 0.02 ns Weight kg mean (SD) 71 (13) 79 (15) ns NT-proBNP pg/ml (median and interquartile range) 4420 (1690–14350) 9335 (3375–13350) ns LVEF % mean (SD) 36 (13) 33 (12) Preserved ejection fraction CHF n (%) 3 (23) 2 (11) Systolic CHF n (%) 10 (77) 16 (89) NYHA class n (%)II 1 (5.5)III 13 (100) 16 (89) IV 1 (5.5) truncated	**Outline of intervention** Initially treated in the ED for ≥48 h & then sent home. The specialist HF nurses followed a written physician directed care plan including adjusting medications. A cardiologist could be consulted. All patients followed-up one day after returning home by nurse. The patients were visited daily or every other day for 5–7 days as appropriate. The home visits stopped when: (1) was symptomatically stable or improving, (2) had stable or falling weight, (3) had no signs of pulmonary rales and (4) had no oedema above the ankle. Patients could contact nurse by phone in office hours. Nurses at intensive cardiac care unit could be reached by telephone after office hours. A cardiologist was always available for phone consultation ≤1 month after the last home visit, the nurse was available for phone counselling.	**Outline of control** Treated in hospital as per hospital treatment guidelines	**Relevant measures & outcomes** No distinction between primary and secondary outcomes **Clinical status** was documented at 1,4,8& 12 mths **Direct costs** for control group based on compensation paid to hospital and for home care group based on time & activities of nurses & physicians plus lab tests and i.v diuretic episodes **Readmissions** from hospital data (presumably up to 12mths – not listed in methods)	There was no significant difference in clinical events including readmissions adverse events or in HRQL (measured at baseline too). The total cost related to CHF was lower in the HC group after 12 months (p=0.05) detail of costs Euros HC vs. CC Nurse cost 386 (244-1107) vs. N/A Physician 35(19-74) vs. N/A Transport 96953-127) vs. N/A Total cost for care 586 (334-1125) vs. 3277 (2125-5750) Readmissions 0.5(0.8) vs. 0.6 (0.8) ns

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Mendoza 2009 Garcia-Soleto 2013 **Spain** **Heart Failure**	**RCT** **Intervention:** Hospital at home (HAH) care (n=37) **Control:** Inpatient hospital care (IHC) in a cardiology unit (n=34)	**Inclusion criteria:** Patient of 65 years and over With diagnosis and prognosis evaluation of HF since at least 12 months prior to the study NYHA functional class II or III before coming to ED due to exacerbation **Exclusion criteria** Admitted in the preceding 2 months for deterioration of HF or acute coronary syndrome Presence of severe symptoms such as sudden worsening of HF Poor prognosis factors (haemodynamic instability, severe arrhythmia, baseline creatinine above 2.5 mg/dL) No response to treatment in the ED Active cancer, severe dementia, or any other disease at an advanced stage indicating life expectancy of less than 6 months Acute psychiatric diseases, active alcoholism Active pulmonary tuberculosis Those living in a psycho-geriatric institution No guarantee of all-day supervision Absence of a telephone at home or living more than 10 km from the hospital **Baseline characteristics of participants IHC vs. HaH** Women, n (%) 10 (29.4) 19 (51.4) 0.06 Age, mean +SD 79.9+6.3 78.1+6.2 0.20 Admissions for HF in previous year 0.41+0.86 0.65+0.86 0.13 O2 saturation in ED 91.4+5.2 93.2+4.6 0.12 Functional Class NYHA II, n (%) 23 (67.6) 19 (51.4) Functional Class NYHA III, n (%) 11 (32.4) 18 (48.6) 0.16 Atrial fibrillation, n (%) 16 (47) 21 (56.8) 0.49 LVEF ≥45%, n (%) 24 (70) 23 (62.1) LVEF , <45%, n (%) 10 (29.4) 14 (37.8) 0.13 NT-proBNP (pg/mL) 4056+5352 3864+3720 0.86 Charlson index 2.1+1.3 2.5+1.5 0.35	**Outline of intervention** Characteristics of the HaH unit explained whilst still in ED. Given information sheet with contact phone numbers. Within 12–24 h of the ED visit, patients received scheduled & if necessary, urgent visits to their homes from an internal medicine specialist & a nurse, (staff of the HaH unit). If deterioration occurred outside the working hours (8am-9 pm every day of yr), patients & family were instructed to call 112 to explain they were HaH patients. Samples were taken for lab tests and ECGs were performed in patient's home X-ray & echocardiography at hospital was as accessible for HaH patients as for in-patients. Generally all patients were visited daily by a specialist nurse. Patients were visited by a physician daily or every other day depending on condition. Treatment in HaH finished with referral to primary care after recovery or, in case of deterioration or no response to treatment, with transfer to the cardiology ward.	**Outline of control** Patients were admitted to hospital, cardiology ward & were managed by the usual staff of cardiology specialists and nurses, in accordance with guidelines.	**Relevant measures & outcomes** No distinction between primary and secondary outcomes ***Effectiveness*** Necessity to transfer the patient from HaH to IHC during the first admission Mortality due to any cause, re-admission due to HF, or another cardiovascular event (stroke, acute coronary syndrome, and coronary revascularization) during 1 year of follow-up. Functional status -Barthel index Health-related quality of life -SF-36 since first admission up to 12 months later ***Costs*** Cost of the stay Medication, diagnostic tests (electrocardiography, echocardiography, laboratory tests, and chest X-ray), consumables, and transport. visits to HF clinic, primary care physician or ED, as well as re-admissions. For re-hospitalizations, the cost of the admission was estimated as the average cost per day incurred during the first admission for each group.	Clinical outcomes were similar after initial admission and also after the 12 months of follow-up. Death or re-admission due to HF or a cardiovascular event occurred in 19 patients in IHC and 20 in HaH (P=0.88). Changes in functional status and health-related quality of life over the follow-up period were not significantly different. Average cost of initial admission 4502±2153E in IHC and 2541±1334E in HaH (P< 0.001). During 12 months of follow-up, the average expenditure was 4619+7679E and 3425+4948E (P= 0.83) respectively.

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Tibaldi 2009 Italy **Heart Failure**	**single blind RCT** **Intervention:** Physician led - Geriatric Home Hospitalization Service (GHHS; n=48) **Control:** Patients were randomly assigned to the general medical ward (GMW; n=53)	**Inclusion criteria:** ≥75 years with a pre-existing diagnosis of CHF (stage C AHA) & persistent functional impairment indicative of NYHA class III or IV status presenting at hospital ED for acute decompensation (defined)& in need of hospital care. Additional inclusion criteria were appropriate care supervision at home, telephone connection, living in the hospital at- home catchment area, informed consent, at least 1 previous admission for acute CHF, and need for intravenous drug infusion. **Exclusion criteria** New-onset heart failure; absence of family and social support; need for mechanical ventilation, hemodialysis, or intensive monitoring; severe dementia ; terminal malignant neoplasm; severe renal impairment; hepatic failure; serum hemoglobin level less than 9 g/dL; and planned cardiac surgery(eg, valve replacement). **Baseline characteristics of participants** Long list of demographic & clinical baseline – truncated GHHS vs. GMV Mean age 82.2 (5.2) vs. 80.1(4.9) p=0.04 Male (%) 22(46) vs. 30 (57) Married (%) 22 (46) vs. 24 (45) Family support at home (%) 48(100) vs. 53(100) Length of disease (yr) 5.4 (4.7) vs. 5.2 (4.7) plus clinical symptoms both cardiovascular & general including functional status (Barthel index) depression (GDS) MMSE, MNA, comorbidity measured by CIRS 3.6 (1) vs. 3.4 (2) All ns except age	**Outline of intervention** The team has 7 cars, is multidisciplinary and consists: 4 geriatricians, 13 nurses, 3 physio-therapists, 1 social worker &1 counselor working together as a team, with daily meetings 7 days a week. In ED all necessary diagnostic tests are provided and then the patient moves home by ambulance, usually within a few hours. Medical consultation with other hospital specialists is possible in the hospital or at the home of the patient. Treatments included physician and nurse visits, standard blood tests, pulse oximetry, spirometry, electrocardiography, echocardiography etc (as per hospital) Patients treated at home and family members obtained adequate Education e.g. early recognition of symptoms. Protocols for prevention of nosocomial infections, bed sores, and immobilization are routinely adopted for frail elderly inpatients. In the first days after admission to GHHS patient was visited at home on a daily basis by physicians and nurses. In the following days this care is tapered off as appropriate Consultation with cardiologists or other hospital specialists was possible. Physicians and nurses were available at all times for urgent home visits.	**Outline of control** The inpatient control group (GMW) received routine hospital care. Protocols for prevention of nosocomial infections, bed sores, and immobilization are routinely adopted for frail elderly inpatients.	**Relevant measures & outcomes** ***Primary outcome*** Mortality at 6 months. ***Secondary outcomes*** morbidity (infections, delirium, bed sores, deep vein thrombosis, and falls) during hospitalization, admissions to a nursing home, and subsequent hospital admissions related to any cause	***Primary outcomes*** Patient mortality at 6 months was 15% in the total sample, without significant differences between the 2 settings of care. (7 vs. 8 deaths) ***Secondary outcomes*** The number of subsequent hospital admissions was not statistically different in the 2 groups 8 (17%) vs. 18 (34%) mean (SD) time to first additional admission was longer for the GHHS patients (84.3 [22.2] days vs 69.8[36.2] days, *P*=.02). Only the GHHS patients experienced improvements in Depression (GDS) +1.48 (1.860 vs. +0.12 (3.36) p=0.02) nutritional status (MNA) -0.86(1.12) vs. -0.27 (1.78) p=0.05 Quality-of-life(NHP) +1.09 (2.57 vs. +0.18 (1.94) p=0.046

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Ricauda 2008 Italy COPD	**Single blind RCT** **Intervention:** Geriatric home hospitalization service (GHHS, n=52) **Control:** General medical ward (GMW, n=52)	**Inclusion criteria:** Patients ≥75 yrs with a diagnosis of acute exacerbation of COPD, defined on Anthonisen criteria as an increase in breathlessness, sputum volume, or purulence for at least 24 hours, admitted to the ED & requiring hospitalization. Additional inclusion criteria were appropriate care supervision in the home, telephone connection, living in the HaH & informed consent. **Exclusion criteria** Absence of family and social support; severe hypoxemia (partial pressure of oxygen <50 mmHg); severe acidosis or alkalosis (pH <7.35 or >7.55); suspected pulmonary embolism; suspected myocardial infarction; severe comorbid illness as defined by presence of need for hemodialysis, severe renal impairment (glomerular filtration rate <20 mL/min), cancer (except skin cancer), hepatic failure, or severe dementia (Mini-Mental State Examination score <14). **Baseline characteristics of participants** Intervention vs. control Age, mean ±SD 80.1 ±3.2 79.2 ± 3.1p=0 .20 Male, n (%) 29 (56) 39 (75) p=0.06 Married, n (%) 27 (52) 29 (56) .84 Family support n (%) 52 (100) 52 (100) p=0.89 Current smoker, n (%)7(13)6(11) p=0.97Ex-smoker, n (%) 34 (65) 35 (67) p=0.95 FEV1, mean ±SD 0.92 ±0.4 1.04 ± 0.5 p=0.18 % of predicted FEV1 38, 47 Home oxygen use, n(%)18 (35)12 (23) p=0.45 Arterial blood gas, mean ±SD pH 7.40 ± 0.04 7.41 ± 0.03 .19 PP of O_2 69 ± 19 65 ±±14 .p= 0.23 PP of CO_2 44 ± 12 46 ± 12 .47 ADL score, mean ± SD± 2.3 ± 2.2 1.9 ± 2.2 p=0.36 IADL score, mean ± SD 7.1 ± 4.9 8.1 ± 4.2 .27 GDS score, mean ± SD 16.1 ± 6.1 17.2 ± 6.8 .45 Comorbidity index 2.6 ± 1.5 3.0 ± 1.8 p=0.24	**Outline of intervention** **Intervention delivered by;** **"**a physician-led substitutive hospital-at-home model of care" Patients assigned to HaH were immediately transferred home by ambulance. At home, a multi-dimensional geriatric assessment was conducted & patients received hospital-level treatment& services, as their condition dictated. (Physician and nursing visits, standard blood tests, pulse oximetry, electrocardiogram, spirometry,echocardiogram, echographs and Doppler ultrasonographs,oral & intravenous medication administration, including antimicrobials & cytotoxic drugs, oxygen therapy, blood products transfusion, central venous access, surgical treatment of pressure sores, physical therapy & occupational therapy The HaH program emphasized patient & caregiver education about the knowledge of the disease, giving advice about smoking cessation, nutrition,management of activities of daily living & energy conservation, understanding & use of drugs, health maintenance, & early recognition of triggers of exacerbation that required medical intervention.	**Outline of control** **Intervention delivered by:** The inpatient control group received routine hospital care	**Relevant measures & outcomes** ***Primary outcomes*** Hospital readmission & mortality rates at 6 months. ***Secondary outcomes*** Depression status -Geriatric Depression Scale, functional status- Katz activities of daily living & Lawton instrumental activities of daily living Cognitive status -Mini-Mental State Examination, Quality of life -the Nottingham Health Profile Nutritional status -Mini Nutritional Assessment, Caregiver characteristics -Relatives' Stress Scale, & satisfaction using ad hoc questionnaire for Scale. Costs of care were compared for the acute episode.	***Primary outcomes*** GHHS vs. GMW Hospital readmissions at6mths 42% vs 87%, P= 0.001 Cumulative mortality at 6 mths was 20.2% in the total sample, No significant differences between grps. ***Secondary outcomes*** Mean length of stay 15.5 ±9.5 vs 11.0 ± 7.9 days, P= 0.010 Only GHHS patients experienced improvements in depression and QoL scores but ns between grps There were no differences in functional, cognitive, nutritional, or caregiver burden outcomes. Satisfaction at discharge was very good or excellent for 94% vs. 88% (P=0.83) (On a cost per patient per day basis, ($101.4 ± 61.3 vs $151.7 ± 96.4, P=0.002).

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Rodriguez-Cerillo 2009 Spain non-massive Pulmonary embolism	**COS** **Intervention:** Home hospitalization (HH) (n=30) **Control:** Conventional Hospitalization (CH) (n=31)	**Inclusion criteria:** *For trial* Non-massive pulmonary embolism • No contraindications for treatment with low MW heparin • Absence of moderate to severe renal failure • Haemodynamic stability • O2 saturation higher than 92% breathing room air • No signs of heart failure • No arrhythmia • No haemoptysis *For HH* • Agreement to admission to our HH unit • A valid caregiver at home • Residence in our health area • A condition amenable to home management **Exclusion criteria** massive PE, haemodynamic instability, oxygen saturation lower than 92% on room air, heart failure, haemoptysis, arrhythmia & contraindication for treatment with low MW heparin **Baseline characteristics of participants** Age 66.8 (27–91) 66.7 (31–90) n.s Sex (males) 30% 54.8% n.s Diagnosed neoplasm 13.3% 9.7% n.s Associated DVT 40% 29% n.s Prior TED 0% 19.3% 0.05 Dementia 23.3% 6.4% n.s. Hypertension 30% 45.1% n.s. Ischaemic heart disease 6.6% 9.6% n.s. Thrombophilia 3.3% 0% n.s Recent surgery 3.3% 6.4% n.s Unilateral involvement 70% 61.3% n.s Bilateral involvement 30% 38.7% n.s Diagnosed by helical CT 26.6% 38.7% n.s	**Outline of intervention** **No detail**	**Outline of control** **No detail**	**Relevant measures & outcomes** No distinction between Primary and secondary outcomes Major and minor bleeding Re-thrombosis, Clinical course Unexpected returns to hospital Need for hospital re-admission in the following 3 months.	All comparisons ns Mean stay length HH vs. CH 8.9 days (7–14 days), vs. 10.6 days (6–20 days). All patients in study had a favourable clinical course. No major bleeding, re-thrombosis, or death occurred. One patient on HH experienced an abdominal wall haematoma in the area of administration of the low MW heparin. One patient admitted to hospital experienced a haematoma in the right arm related to blood sampling for laboratory tests. No patient with HH had infectious complications. Three patients admitted to hospital were diagnosed of urinary tract infection. No HH patients required unexpected return to hospital during admission. During follow-up, two patients required hospital admission, one in each group. The cause was not related to the thromboembolic disease.

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Carratala 2005 Spain Pneumonia	**Open RCT** **Intervention:** Outpatient care with oral levofloxacin therapy or hospitalization with sequential intravenous and oral levofloxacin therapy. (n=110) **Control:** Hospitalisation (n=114)	**Inclusion criteria:** All immunocompetent patients who were at least 18 years of age and had received a diagnosis of community acquired pneumonia in the emergency department (24 hrs per day, 7 days per week) Community acquired pneumonia was defined as the presence of a new infiltrate on chest radiography plus at least 1 of the following: fever (temperature ≥38.0 °C) or hypothermia (temperature <35.0 °C), new cough with or without sputum production, pleuritic chest pain, dyspnea, or altered breath sounds on auscultation. **Exclusion criteria** Neutropenia, HIV infection, transplantation, or splenectomy or who were taking immunosuppressive drugs **Baseline characteristics of participants** Male 69 (62.7) 66 (57.9) Female 41 (37.3) 48 (42.1) Mean age ± SD, *y* 67.5 ± 11.8 64.9 ± 13.4 Alcohol consumption ±80 g/d, *n (%)* 13 (12.4) 7 (6.4) Current tobacco smoking, *n (%)*‡ 21 (19.8) 24 (21.8) Influenza vaccine in current season, *n (%)*§ 44 (42.7) 49 (46.2) Pneumococcal vaccine in the previous 5 yrs, *n (%)*± 15 (15.6) 13 (13.1) Comorbid conditions, *n (%)* 71 (64.5) 78 (68.4) Mean oxygen saturation ± SD, *%* 94.5 ± 2.0 94.5 ± 1.8 Multilobar pneumonia, *n (%)* 8 (7.3) 9 (7.9) Risk class, *n (%)* II 55 (50.0) 63 (55.3) III 55 (50.0) 51 (44.7) Mean PSI score ± SD 70.0 ± 11.6 66.9 ± 12.5	**Outline of intervention** Outpatients were given oral levofloxacin (500 mg/d), and received detailed written information about their pneumonia diagnosis and their treatment plan, as well as emergency contact telephone numbers for a nurse or investigator physician. Patients were visited at home by a nurse 48 hours after emergency department discharge. The visit included assessment of vital signs and measurement of oxygen saturation by pulse oximetry. If the nurse thought that a patient's condition was not improving (worsening of baseline vital signs, oxygen saturation, or both), one of the investigators made an additional visit. The nurse was involved only in outcome assessment. Patients were seen at the outpatient clinic at days 7 and 30 after pneumonia diagnosis.	**Outline of control** Hospitalized patients received sequential intravenous and oral levofloxacin (500 m and received detailed written information about their pneumonia diagnosis and their treatment plan, as well as emergency contact telephone numbers for a nurse or investigator physician g/d) Patients assigned to hospitalization were seen daily during their hospital stay by attending physicians and by at least 1 of the investigators. Criteria for early switching from intravenous to oral levofloxacin were a respiratory rate of 24 breaths/min or less, a pulse rate of 100 beats/min or less, a temp of 37.8 °C or lower on 2 occasions at least 8 hours apart, and maintenance of adequate oral intake. Physicians were advised to discharge patients after their clinical condition stabilized, in accordance with previously recommended criteria. Patients were seen at the outpatient clinic at days 7 and 30 after pneumonia diagnosis.	**Relevant measures & outcomes** ***Primary outcomes*** % of patients with an overall successful outcome at the end of treatment, according to 7 predefined criteria: cure of pneumonia (as defined later), absence of adverse drug reactions, absence of medical complications during treatment, no need for additional visits, no changes in initial treatment with levofloxacin, **absence of subsequent hospital admission in the 30 days after randomization**, and absence of death from any cause in the 30 days after randomization. ***Secondary outcomes*** Patients' quality of life & satisfaction	Intervention vs. control ***Primary outcome*** Successful outcome was achieved in 83.6 vs. 80.7% (absolute difference, 2.9 % points [95% CI, ±7.1 to 12.9 % points]). % patients with adverse drug reactions (9.1% vs. 9.6%), Subsequent hospital admissions (6.3% vs. 7.0%), Overall mortality (0.9% vs. 0%) Medical complications (0.9% vs. 2.6%), ***Secondary outcomes*** All ns Quality of life (9.1% vs. 9.6%) Satisfied with overall care (91.2% vs. 79.1%; absolute difference, 12.1% [CI, 1.8 to 22.5 % points]).

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Kalra 2005 UK Stroke	**RCT** **Intervention:** **1)ST (n=152)** The stroke team involved management on general wards with specialist team support. The team undertook stroke assessments and advised ward-based nursing and therapy staff on acute care, secondary prevention and rehabilitation aspects. **2) DC (n=153)** **Domiciliary care provided management at home under the supervision of a GP and stroke specialist with support from specialist team and community services. Support was provided for a maximum of 3 months**. **Control:** Usual care **SU (n=152)** The stroke unit provided 24-hour care provided by a specialist multidisciplinary team based on clear guidelines for acute care, prevention of complications, rehabilitation and secondary prevention.	Patients were included within 72 hours of stroke onset. The research team was notified by telephone or fax by GPs for patients at home, and by accident and emergency (A&E) services for suspected stroke patients presenting to the casualty department. **Inclusion criteria:** Patients with disabling stroke who could be supported at home with nursing, therapy and social services input on initial assessment were included in the study. **Exclusion criteria** Patients with mild stroke, severe strokes, already admitted to hospitals, and those with unusual or atypical neurological features who required specialised assessments or investigation to establish a diagnosis of stroke. Patients who were institutionalised or had severe disability (Rankin 4 or 5) before stroke **Baseline characteristics of participants SU vs. ST vs.HC** Median age (years) (IQR) 75 (72–84) 77.3 (71–83) 77.7 (67–83) No. of females (%) 69 (46.6) 76 (50.6) 68 (45.6) Living alone (%) 50 (33.7) 55 (36.6) 50 (33.5)	**Outline of intervention** **ST** Patients were managed on general wards & under care of admitting physicians. All patients were seen by specialist team: doctor (specialist registrar grade), a nurse (grade G), a physiotherapist (senior I) and an occupational therapist (senior I) with expertise in stroke management. Patients were assessed by the specialist team, which undertook a diagnostic evaluation and assessment for needs. Ward provided the day-to-day treatment, the team advised on specialist aspects of stroke care. It reviewed progress and treatment of individual patients with ward team & helped in discharge planning and setting up of post discharge services. The team provided counselling, education and support to the family, identified expectations and advised about realistic outcomes in the context of previous morbidity and present deficits. **DC** Patients were managed in own home by a specialist team consisting of a doctor (specialist registrar), a nurse (G grade) & therapists (senior I grades), with support from district nursing and social services for nursing and personal care needs. Patients were under the joint care of the stroke physician and GP. Investigations, including CT scanning, were performed in outpatient s. Therapy was provided by members of the specialist stroke team. Each patient had an individualised integrated care pathway outlining activities and the objectives of treatment, which was reviewed at weekly multi-disciplinary meetings.	**Outline of control** **SU** Care was provided by a stroke physician supported by a multidisciplinary team with specialist experience in stroke management. There were clear guidelines for acute care, prevention of complications, rehabilitation and secondary prevention, and a culture of joint assessments, goal setting, coordinated treatment and discharge planning. A coordinated multidisciplinary approach was adopted towards rehabilitation, with emphasis on early mobilisation. All patients had an individualised rehabilitation plan with clearly defined goals based on joint assessments. Patient participation was encouraged, with focus on motivation and providing an enriched environment.	**Relevant measures & outcomes** ***Primary outcomes*** Death or institutionalisation at 1 year. Dependence - modified Rankin Scale (mRS), ***Secondary outcomes included*** Orgogozo scale, BI and FAI for disability, the mRS for handicap EuroQol-quality of life of patients and their carers.	Mortality and institutionalisation at 1yr were lower on SU vs.ST or DC Significantly fewer patients on SU died compared with ST The proportion of patients alive without severe disability at 1 year was also significantly higher on SU vs. ST or DC. These differences were present at 3 & 6 mths after stroke. Stroke survivors on SU showed greater improvement on basic activities of daily living compared the other two grps. Achievement of higher levels of function was not influenced by strategy of care. QoL at 3mths was significantly better in SU & DC patients. There was greater dissatisfaction with care with ST vs. SU or DC. Poor outcomewith DC and ST was associated with Barthel Index <5, incontinence and with ST, age >75 years. The total costs of stroke per patient over 12mths were £11,450 for SU, £9527 for ST & £6840 for DC The mean costs per day alive for the SU were significantly less than those for the ST , but no different from DC patients. Costs for DC were significantly less than for those managed by the SU or ST.

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Rodriguez-Cerrillo 2013 Spain uncomplicated diverticulitis	**Prospective controlled study** **Intervention:** Patients stayed 24 h in the Observation Ward within ED prior to discharge and treatment at home. (n=34) **Control:** Traditional hospitalization (n=18)	**Inclusion criteria:** ≥70 years diagnosed with uncomplicated diverticulitis (The existence of abscess, fistula, bowel obstruction and peritonitis) Patients who were willing to be treated at home and had a caregiver 24 h a day were transferred to HaH. The rest of the patients were admitted to conventional hospitalization. **Exclusion criteria** Patients with complicated diverticulitis, β-lactam allergy or who required admission to hospital for other pathology **Baseline characteristics of participants** intervention vs. control Age 77 (71–90) 79 (71–98) Sex (female) 28 (82.4%) 16 (84.2%) Cardiopathy 9 (26.5%) 6 (31.6%) Diabetes mellitus 4 (11.7%) 2 (10.5%) Chronic renal failure 4 (11.7%) 1 (5.2%) Neoplasm 1 (2.9%) 1 (5.2%) COPD 1 (2.9%) 1 (5.2%) Corticosteroids 4 (11.7%) 2 (10.5%) Previous diverticulitis 7 (20.5%) 3 (15.8%) Abdominal pain 34 (100%) 19 (100%) Fever 9 (26.5%) 6 (31.6%) Diarrhea 6 (17.6%) 3 (15.8%) Leucocytosis 7 (20.5%) 3 (15.8%)	**Outline of intervention** **Intervention delivered by;** All patients were given Ertapenem after diagnosis. Patients in HaH grp stayed 24 h in the observation ward within ED prior to discharge. At home, nurses administrated Ertapenem every day. The physician conducted 2–3 home visits per week, depending on the patient's clinical course. On admission patients were provided with a phone number to contact the unit if any problem arose. Intravenous antibiotic was changed to oral therapy (amoxicillin–clavulanate) after 4–6 days of treatment until complete 10 days of treatment.	**Outline of control Intervention delivered by:** All patients were given ertapenem after diagnosis & experienced traditional hospitalisation	**Relevant measures & outcomes** No primary nor secondary outcomes were defined	A small amount of free fluid was present in 38% of patients treated with HaH and 42% of patients in hospital. All patients had a good clinical evolution. None of the patients treated with HaH needed be transferred to hospital. Mean stay was 9 days in HaH vs. 10 days in Hospital. The cost of each patient with diverticulitis treated at home was 1368 euros cheaper than the cost of a patient treated in the hospital (fewer staff and important reduction of maintenance costs).

Author Year Country	Study	Participants	Intervention		Control	Outcomes assessed	Results
Leff **[3066]** **2005** **USA** **Plus** Leff 2009 [2545] Frick 2009 [0158]	**Prospective quasi experimental** 2 consecutive 11 month phases **Intervention:** Treatment in a hospital-at-home model of care that substitutes for treatment in an acute care hospital. Offered In the 2nd phase of study n=169 **Control:** Described as 'observation group' in the first phase of study. Eligible patients were identified and followed through usual hospital care. n=286 **Aim:** 'to evaluate the safety, efficacy, clinical and functional outcomes, patient and caregiver satisfaction, and costs of providing acute hospital level care in a hospital at home that substituted entirely for admission to an acute care hospital for older persons.' **Setting:** **Intervention** (if received): At home **Control** **Secondary hospital care** ***Power calculation:*** No	**Inclusion criteria:** Community-dwelling persons ≥65 yrs old, Lived in catchment area In the opinion of a physician not involved in study, required admission to an acute care hospital for these illnesses: community-acquired pneumonia, exacerbation of chronic heart failure or chronic obstructive pulmonary disease, or cellulitis. Required to meet validated criteria of medical eligibility for hospital-at-home care. **Exclusion criteria** Most common reasons for medical ineligibility were uncorrectable hypoxemia, suspected myocardial ischemia, and presence of an acute illness, other than the target illness, for which the patient was required to be hospitalized. **Baseline characteristics of participants at all sites (Stats shown if signif)** Observation vs. intervention Age (SD) 77.3 (6.6) vs.77.2(7.0) % female 34 vs. 42% % white 90 vs.86% **% in poverty 11 vs.19% p=0.027** **% live alone 43 vs.33% p=0.022** Mean mini mental state (SD)25.5 (4.2) vs. 25.2(4.4) Mean Charlson score (SD) 3.1 (2.0) vs.3.0 (1.8) **Mean medications (SD) 6.8 (3.9) vs. 8.1(4.5) p=0.002** %Primary admission diagnosis Pneumonia 31vs. 32% COPD 32 vs.28% Cellulitis 12 vs 18% CHF 25vs.22%	The study was conducted in 3 Medicare managed care (Medicare +Choice) plans at 2 sites and at a Veterans Administration medical centre. Univera Health and Independent Health, in Buffalo, New York, are Medicare + Choice plans These 2 plans collaborated to provide hospital- at-home care and made up 1 study site (site 1). The Fallon Health Care System (site 2), in Worcester, Massachusetts, operates a not-for-profit Medicare +Choice plan, and the Fallon Clinic, a for-profit multispecialty physician group, provides care on a capitated basis to Medicare + Choice beneficiaries. The Portland, Oregon, Veterans Administration Medical Center (site 3) is a quaternary care and teaching facility. A patient requiring admission to the acute care hospital for a target illness was identified in an ED or ambulatory site and his or her eligibility status was determined. Non-study medical personnel, usually ED physicians, made the decision to hospitalize the patient. All patients who were offered but who declined hospital-at-home care were admitted to the acute care hospital. Study coordinators verified the patient's eligibility for HaH using a standard protocol at enrolment. Most patients were identified the morning after admission.	**Outline of intervention &who delivered** 1 Nov 2001-30 Sep 2002 Patients evaluated by HaH physician either in ED or after ambulance transfer to home. HaH nurse met ambulance at patient's home and provided direct one-on-one nursing for an initial period of ≤ 8hrs at site 3 and ≤24 hrs at sites 1 & 2. followed by intermittent nursing visits and HaH physician at least daily. HaH physician was available 24 hours a day for visits. Nursing and other care components, e.g. durable medical equipment, oxygen therapy were provided and some services e.g. home radiology, support provided by independent contractors. Lifeline devices were provided for patients living alone. Diagnostic tests , IV fluids, IV antimicrobial agents, etc. and oxygen/respiratory therapies were provided at home. Patient was followed by same physician until discharged to primary care	**Outline of control** 1 Nov 1990-30 Sep 2001) Eligible patients identified & followed through usual hospital care.	**Relevant measures & outcomes** **No distinction between primary and secondary outcomes** Intervention group comprised all patients eligible for hospital-at-home care, irrespective of where they were treated. [thus some outcomes are NOT useful to us but some measures are HaH specific] **Mean LoS (SD) days [Leff 2005]** ***Mean time in ED (SD) in hrs*** ..... Sub-analysis of HaH vs. Non-HaH (i.e. different to main report [Leff 2009] ***Changes in ADL and IADL from 1mth before admission -2 weeks after intervention*** **Costs** ***Within each health system and per condition*** [Frick 2009] **Overall summary** 'The HaH care model is feasible, safe, and efficacious for certain older patients with selected acute medical illnesses who require acute hospital-level care.' Leff 2005 HaH care is associated with modestly better improvements in IADL status and trends toward more improvement in ADL status than traditional acute hospital care. Leff 2009 Total costs seem to be lower when substitutive HaH care is available for patients with CHF or COPD disease.Frick2009	Intervention vs. control **Mean LoS (SD) days** **4.9 (9.9) 3.2 (2.5) p =0.004** ***Mean time in ED (SD) in hrs*** **6.4(1.8,11.6)SD 1.9 vs. 5.5(1.0,21.3) SD3.2** **P=0.001** [Leff 2005] ---------- ***Changes in ADL and IADL from 1mth before admission -2 weeks after intervention*** ADL 0.39(3.13) vs. -0.6(3.09) p=0.1 **IADL 0.74(2.86) vs. -0.70(2.68) p=0.007** [Leff 2009] **Costs** ***Within each health system and per condition*** **Mean (SD)** Overall **$5081(4427)vs.$7480(8113) p<0.001** Pneumonia $5272(6036) vs. $6761(6451) NS Congestive heart failure **$3310(2118) vs. $6399(6643) p≤0.001** COPD **$4293(3806) vs. $6500(7305) p≤0.05** Cellulitis $4262(2309) vs. $7287(11471) NS [Frick 2009]

Hospital in Nursing/Care Home (HNCH) (n=2)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Crilly 2010 Australia	**'quasi experimental'** **[Controlled (his) study]** **Intervention:** Hospital in the nursing home (HINH) n=62 **Control:** Usual in-hospital care n=115	**Inclusion criteria:** Reside in an ACF. Have a signed GP request for HINH review from the ACF. Be of any age (usually≥ 65 yrs). Present with an illness that required hospital services but not necessarily admission e.g. UTI & could have treatment e.g. antibiotics continued by ACF staff. Prior to start of HINH, patients who would have fit inclusion criteria for hospital admission **Exclusion criteria:** ACF residents who required extensive treatment that could not be managed in ACF or who required specific services that could only be received in hospital e.g. surgery **Baseline characteristics of participants** **HINH vs. Control** Age (SD) 85(7.1) vs.84.6(6.6)years Triage category 3.2 (0.7) vs.3.2(0.7) Female 76vs. 75% Diagnostic category: Respiratory 24 vs.26% Cellulitis 18 vs.17% Kidney/urinary tract 18vs.16% Cardiac 10 vs. 10 % Abdominal/GI 8vs.8% Viral/sepsis 7 vs.6% All other 16 vs.17%	In the ED. Enrolments were made by HINH programme manager (registered nurse) with programme director (ED director), GPs and ACF nursing staff, as appropriate. After hours and on weekends, if patient was suitable for HINH , they stayed in ED short stay unit and were reviewed by HINH nurse on next weekday. **Outline of intervention** The HINH nurse checks with the ACF registered nurse and patient on the patients' progress initially on a daily basis and then every couple of days. Discharge occurs when required treatment has ceased. This completes the patients' hospital-affiliated episode. **Intervention delivered by:** HINH programme delivers acute care nursing support services, medication and equipment to the ACF registered nurse and/or enrolled nurse. These services may include initial training and education regarding antibiotic or IV fluid administration; specific wound treatment and dressing procedure (with dressing materials); suprapubic catheter care, behaviour management and palliative care.	**Outline of control** The comparison group was selected from patients who presented to ED and were subsequently admitted during the same time period. To be included in this group, the patients had to reside in an ACF and be aged ≥65yrs. ACF residents who presented to the ED were in some cases not enrolled in HINH because they had a medical problem that was judged as possibly requiring in-hospital admission services beyond those offered by the HINH. **Intervention delivered by:** No details but presumably usual hospital staff	**Relevant measures & outcomes** ***Hospital LOS (days)*** ***ED LOS (hours)*** ***Episode of care (total time) LOS (days)*** ***Long (≥6days) vs. short hospital LOS*** ***Long (≥8 days) ED LOS vs. short*** ***Long episode of care (≥6 days)*** ***Hospital readmissions within 28 days*** ***Costs*** None	HINH vs. Control Mean (SD) ***Hospital LOS*** **2.19 (0.82) vs.6.2(0.59) days p<0.001** ***ED LOS*** **9.94(0.66) vs. 7.01(0.47) hrs p=0.005** ***Episode of Care LOS*** 9.56(1.26)vs. 6.20(0.59) days p=0.14 Percentages ***Hospital LOS 6+days*** **9.6 vs. 40 p<0.001** Episode of care 6+days 46.8 vs.40.0 p=0.35 ***LOS in ED 8+ hours*** **50.0vs.33.9 p=0.05** ***Readmission in 28 days*** 11.3 vs. 11.3 p=0.99

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Lau **2013** **Australia**	**Controlled (his) Case series** **Intervention** Treatment in residential care facilities (TRC) grp **n=95** **Control** Hospital-based aged care unit (ACU) **n=167**	**Inclusion criteria:** Patient and/or family consent Capacity within HITH to accept the patient Facility able to manage the care needs of the patient in the residential aged care facility (RACF) **Exclusion criteria:** Lack of consent from patient and/or family. Behavioural disturbances, which may prevent the delivery of care e.g. aggressive behaviour and frequent removal of IV, access device. History of recent falls, which may impact on the delivery of care in the RACF. If there was conflict regarding management, further input and discussion were carried out in ACU. **Baseline characteristics of participants** TRC vs. ACU **Age** 83.5 vs.82.8yrs **Female** 53 vs.59% **Non-English speaking** 42 vs.48% **High level of nursing homecare** 72 vs.76% **Dementia 77.9vs.45.5% p<0.001** **Charlson score** 7.1 SD 1.9 vs. 7.2 SD 2.3	In the ED the acuity of presenting complaint was triaged to maximize service capacity. Overnight referrals were assessed next morning, (those who presented after hours were put in Short Stay Unit adjacent to ED for assessment. TRC generally provided once daily visits for patient. The geriatrician & team members would use clinical judgement to determine if a patient was suitable for TRC **Outline of intervention** Treatment in Residential Care facilities (TRC) delivered by the Residential Care Intervention Program into the Elderly (RECIPE) service between July-Oct 2008. **Appropriate Clinical Diagnosis** Dehydration, Pneumonia, Urinary Tract Infection, Gastroenteritis, Deep Venous Thrombosis, Terminal care support. **Treatment can therefore include any of the following:** IV antibiotics & IV fluids Anticoagulation Oxygen therapy (low flow) Appropriate Allied Health intervention Palliative support* Referral to other appropriate support programs * [TRC also offered palliative care as appropriate. If patient's condition changed and management could not be continued, transfer into acute hospital was organized. If patients had uncertain prognosis, treatment was given, followed by palliative care if no response despite optimal treatment.] **Intervention delivered by:** Geriatrician, registrar and nursing staff with access to allied health staff such as physiotherapy, OT, speech pathology and social work.	**Outline of control** Aged care unit (ACU) Inpatients treated in ACU in preceding year July-October 2007, before existence of TRC. ACU is a service for inpatients who have been admitted from residential care facilities for the management of general medical conditions. **Intervention delivered by:** No details but presumably usual hospital staff	**Relevant measures & outcomes** ***Palliative care*** ***Mortality on discharge*** ***6-month mortality*** ***Rehospitalisation within 1-month*** ***Total hospitalisation at 6 months*** **Length of hospital care/stay** All measured as 'present or not' **Costs** None	TRC vs. ACU ***Palliative care*** **34 (35.8%) 13 (7.8%) <0.001** ***Mortality on discharge*** 11 (11.6%) 20 (12.0%) p=0.924 ***6-month mortality*** 29 (30.5%) 51 (30.5%) p=0.184 ***Re-hospitalization within 1 month*** 20 (21.1%) 35 (21.0%) p=0.986 ***Total re-hospitalization at 6 months*** 39 (41.1%) 68 (40.7%) p=0.963 ***Length of stay*** **Mean (no SD given) 2vs.11 days** **P<0.001** Equivalent of 270 vs. 1840 bed days

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A systematic review to identify and assess the effectiveness of alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission.

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03.05.17

A systematic review to identify and assess the effectiveness of alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission.

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ABSTRACT

Background / objectives

There are some older patients who are 'at the decision margin' of admission. This systematic review sought to explore this issue with the following objective: What admission alternatives are there for older patients and are they safe, effective and cost-effective? A secondary objective was to identify the characteristics of those older patients for whom the decision to admit to hospital may be unclear.

Design

Systematic review of controlled studies (April 2005-December 2016). The protocol is registered at PROSPERO (CRD42015020371). Studies were assessed using the Cochrane risk of bias criteria, and relevant reviews were assessed with the AMSTAR tool. The results are presented narratively and discussed.

Setting

Primary and secondary health care interface.

Participants

People aged over 65 years at risk of an unplanned admission.

Interventions

Any community-based intervention offered as an alternative to admission to an acute hospital

Primary and secondary outcomes measures

Reduction in secondary care use, patient-related outcomes, safety and costs.

Results

Nineteen studies and 7 systematic reviews were identified. These recruited patients with both specific conditions and mixed chronic and acute conditions. The interventions involved paramedic/emergency care practitioners (n=3), emergency

department-based interventions (n=3), community hospitals (n=2), and hospital-at-home services (n=11). Data suggest that alternatives to admission appear safe with potential to reduce secondary care use and length of time receiving care. There is a lack of patient-related outcomes and cost data. The important features of older patients for whom the decision to admit is uncertain are: age over 75 years, co/multi-morbidities, dementia, home situation, social support and individual coping abilities.

Conclusions

This systematic review describes and assesses evidence on alternatives to acute care for older patients and shows that many of the options available are safe and appear to reduce resource use. However, cost analyses and patient preference data are lacking.

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STRENGTHS AND LIMITATIONS OF THIS REVIEW

1. High quality systematic review of controlled studies.
2. Specific focus on admission avoidance interventions for acute care of older people.
3. Studies cover a wide range of acute conditions and acute exacerbation of chronic conditions in older people.
4. Some of the studies are pragmatic in approach and are at high risk of bias.
5. Most studies do not provide associated costs/cost analyses of interventions or patient preference data.

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Introduction

Reducing emergency bed days is one of the biggest challenges currently facing the National Health Service (NHS) in the United Kingdom (UK) and there is considerable pressure to reduce hospital admissions amongst older people throughout the developed world.[1] It has been suggested that clinicians should: 'choose to admit only those frail older people who have evidence of underlying life-threatening illness or need for surgery'.[2] In the UK there has been a 65% increase in hospital admissions for those over 75 years of age in the last decade. Furthermore, people over 85 years of age now account for 11% of emergency admissions and 25% of critical care bed days.[3] The international literature indicates that decisions to admit to an acute hospital are often influenced by inadequate knowledge of the patient or condition, communication difficulties between primary and secondary care, presence of co-morbidities, availability of test results, perceived benefits of in-patient care and patient preferences.[4] A review by NHS England highlighted the need to identify those frail and elderly people who need care but do not have a medical need requiring hospital admission.[3] It is clear that there are some older patients for whom care in the community is safe, perhaps with provision of additional services, and some for whom admission is required to deliver diagnostics or treatment that are only available in hospital. However, for those patients 'at the decision margin', the best path of action may be unclear.[5] The decision may be affected by non-clinical and clinical factors e.g. multi-morbidity, how much risk the patient or family are willing to accept.

Our specific objective was to conduct a systematic review to identify studies of community-based interventions aimed at reducing secondary care use in older patients with acute medical problems potentially requiring unscheduled hospital

admission. A secondary objective was to further confirm the characteristics of those older patients for whom the decision to admit to hospital may be unclear.

Methods

Protocol and registration

The protocol for the systematic review was registered at the PROSPERO register on 14/06/2015. Registration number is: CRD42015020371 (Supplementary material)

Eligibility criteria

Publications of any randomised or non-randomised controlled trial (RCT or nRCT) which fitted our PICO criteria: a **P**opulation aged over 65 years, of either sex living in Organisation for Economic Co-operation and Development countries being considered for an unplanned admission, receiving either an **I**ntervention considered to be an alternative to acute hospital admission or acute hospital admission (**C**ontrol). The studies needed to record at least one of the following as either a primary or secondary **O**utcome: intervention effectiveness in terms of patient's subsequent ED attendance or readmission, patient-related outcomes, safety or healthcare costs.

Information sources and searches

Medline, Medline In-Process, Embase, Cinahl and CENTRAL databases were searched from January 2005-April 2015 inclusive using search terms based on the eligibility criteria. (Appendix 1) An update was run in December 2016 across Medline and Medline In-Process. We included any relevant systematic reviews published 2010- 2016. The decision to time limit the searches was based on the fact that the systematic reviews would cover any older studies and that any evidence not included in these two sources was unlikely to be relevant to the fast changing

primary and secondary health care interface. The King's Fund and Agency for Healthcare Research and Quality websites were also searched in April 2015.[6,7] References were managed using EndNote X6 software and were screened by title and abstract followed by full text, both independently and in duplicate (AH, BD), using predefined inclusion/exclusion criteria. Any disagreements in either stage were resolved using a third reviewer (SP). The reference lists of included studies were checked and forward referencing was conducted using Google Scholar. Authors of included studies were contacted for details of any extra studies.

Data items and collection process

Data from all primary studies (2005-2016) were extracted into a custom-designed table. The main results and conclusions of recent high quality systematic reviews (2010-2016) which included relevant primary studies were also recorded.

***Assessment of risk of bias of individual studies* (Appendix 2)**

The Effective Practice and Organisation of Care Cochrane risk of bias tool was used to critically appraise RCTs and nRCTs.[8]

***Assessment of methodological quality of systematic reviews* (AMSTAR) *(*Appendix 3)**

The AMSTAR checklist was used to assess the quality of the included systematic reviews.[9]

Synthesis of results

The data are presented narratively describing, if present, the most relevant systematic review and/or individual studies for each intervention and, where appropriate, for a specific condition.

In order to identify the characteristics of those older patients for whom the decision to admit to hospital may be unclear, the inclusion/exclusion criteria and demographics of the participants were examined and key features were tabulated alongside the number and references of relevant studies.

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Summary Table: RCT/nRCT and systematic evidence for alternative to admissions for the older population

Intervention/ setting	**Paramedic/ emergency care practitioner**	**Emergency department**	**Community hospital**	**Hospital at home** Heart Failure	**Hospital at home** COPD	**Hospital at home** Pulmonary embolism	**Hospital at home** Pneumonia	**Hospital at home** Stroke	**Hospital at home** Uncomplicated diverticulitis	**Hospital at home** Older population with acute medical problems
Primary studies identified 19 studies over 24 papers n=10 RCT, n=9 nRCT	n=3 (RCT & 2 nRCT) Mason 2007 Gray 2008 Mason 2012	n=3 (RCT & 2 nRCT) Sun 2014 Benaiges 2014 Salvi 2008	n=2 RCT Vicente 2014 Garåsen 2007, 2008ab	n=3 RCT Mendoza 2009/García-Soleto 2013 Tibaldi 2009 Patel 2008	n=1 RCT Ricauda 2008	n=1 nRCT Rodriguez-Cerillo 2009	n=1 RCT Carratala 2005	n=1 RCT (3 arm) Kalra 2005	n=1 nRCT Rodriguez-Cerrillo 2013	n=3 nRCT Leff 2005/2009/Frick 2009 Crilly 2011 Lau 2013
Main conclusions of primary studies Statistically significant differences between alternative care and acute hospital care	Mason RCT **Reduction:** Risk of ED attendance, Risk of hospital readmission. **Increase:** Satisfaction with care Mean duration of care Subsequent unplanned contacts with secondary care **Comparable:** Mortality Two nRCTs report greater reduction in admissions No cost data	Sun RCT **Reduction:** Time of episode of care Less likely to be admitted into hospital Costs **Comparable:** Serious events QoL Satisfaction with care ********** Benaignes nRCT **Reduction:** Readmissions Costs ********** Salvi nRCT no differences	Vincente Data limited. Neither formal analyses nor cost data presented. ********** Garåsen **Reduction:** Hospital readmissions Receiving any care at 26 wks Deaths Total costs & mean costs per patient **Increase:** Observation period **********	Meta-analysis in systematic review	**Reduction:** Readmissions Mean cost per patient **Increase:** Length of stay. **Comparable:** Depression QoL Mortality	**Comparable:** Mean length of stay No major bleeding, thrombosis or death in either group No cost data	**Increase:** Patients were satisfied with care **Comparable:** An overall 'successful outcome' Readmissions QoL Adverse drug reactions Medical complications Mortality No cost data	**Increase:** Mortality & institutionalisation. **Reduction:** QoL scores basic activities of daily living Costs were lower for HaH group but eclipsed by poorer patient outcomes.	Limited data. **Reduction:** Cost reduction of €1368 per patient. **Comparable:** Mean length of stay	Leff **Reduction:** Length of stay Mean treatment cost **Comparable:** Use of health services ED visits or readmission ********** Crilly **Increase:** Longer time in ED **Comparable:** Length of episode of total care No mortality or cost data ********** Lau **Reduction:** Length of stay **Comparable:** Mortality Readmissions No cost data
Systematic review identified	NO	NO	NO	Quaddoura 2015	Jeppesen 2012	Vinson 2012	Chalmers 2011	Shepperd 2016 Chalmers 2011	Varney 2014	NO
Description of, and main conclusions of systematic review				3 RCTs as above used in meta-analysis **Increase:** Time to first readmission HQoL at 6 &12 mths **Reduction:** Costs for index treatment **Comparable:** Rate of readmission All-cause mortality	8 RCTs 7 did not fit inclusion criteria plus RCT detailed above. **Review summary:** Selected COPD patients can be safely & successfully treated at home. Favourable readmission rates. A trend towards reduced mortality rate	7 observation studies plus one nRCT detailed above. **Review summary:** Data are limited, but evidence supports the feasibility & safety of for carefully selected low risk patients.	5 studies comprising variety of designs plus one RCT detailed above **Review summary:** Interventions appear safe. Comparable for mortality, hospital readmissions patient satisfaction. Insufficient data for quality of life or return to usual activities.	Two previous systematic reviews on a mixture of conditions including one RCT described above	Integrative review on admission-avoidance HaH services and included one nRCT described above	

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Results

The systematic review identified four types of intervention from across 19 studies published in 24 papers: paramedic/emergency care practitioners (n=3), emergency department (ED) interventions (n=3), community hospitals (n=2), hospital-at-home services (n=11).[10-33] (PRISMA diagram) (Appendix 4) Ten of the included studies were RCTs and nine were nRCTs.(Summary table) Fifteen studies were conducted in western European countries of which four were in the UK. Two studies were conducted in Australia and two studies in the United States (US). Risk of bias, general intervention description, AMSTAR and study data are detailed in the appendices. (Appendix 1) (Appendix 2)(Appendix 3) (Appendix 4)(Appendix 5)

There was an obvious divide between risk of bias of RCTs and nRCTs with the RCTs generally at low risk for most domains although for some domains there was insufficient information to be make a judgement (Appendix 2). The nRCTs were at high risk from not being randomised and in some studies there was a suggestion of health professional choice in allocation and as, with the RCTs, information was sometimes lacking. Risk of bias of individual studies is detailed below in the relevant section.

The AMSTAR ratings of the systematic reviews was generally good although some reviews did not list details of excluded studies, included studies of high risk of bias and did not perform publication bias analysis. (Appendix 3)

Paramedic practitioner/emergency care practitioner (PP/ECP) interventions (Appendix 4)

Three studies were identified [10-12] and no relevant recent systematic reviews.

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A cluster RCT (Mason 2007), compared PPs with additional training (n=1469) with standard PPs (n=1549) in assessing and treating elderly people following 999 calls with the aim of measuring subsequent emergency care.[10] Similarly, two more recent nRCT investigated the role of ECPs in avoiding ED) attendance/admissions in elderly populations.[11, 12] Gray 2008 was a case-series study of ECP attendances for elderly patients aged over 65 years with a fall (n=233) compared with historical controls (n=772), and Mason 2012 was a cluster controlled study of enhanced ECP care for five care homes (n=256) compared with standard care in five other care homes (n=201). Risk of bias was low for all the domains of the cluster RCT and both of the nRCT were at high risk due to lack of randomisation.

In the cluster RCT, all primary outcomes comparing the intervention with the control group were improved: relative risk of ED attendance within 28 days (RR 0.72 (0.68, 0.75)), relative risk of hospital admission within 28 days (RR 0.87 (0.81, 0.94)), being very satisfied with care (RR 1.16 (1.09, 1.23)) and mean total episode duration in hours (-42.2 (-59.5,-25.0)) with a reported $p<0.001$ for all.[10] The secondary outcome of mortality was comparable between groups, but intervention patients had a greater number of subsequent unplanned contacts with secondary care at 28 days (330 vs. 259 $p<0.01$).

The two nRCTs reported a greater reduction in admissions when comparing the intervention with normal ECP practice but these results are of limited use due to the high risk of bias of the studies.[11, 12]

None of the studies of PP/ECP interventions provided details of cost data or cost-effectiveness analysis.

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Emergency department (ED) interventions (Appendix 4)

The searches identified one RCT (Sun 2014) which was assessed to be at low risk of bias, and two nRCT (Benaiges 2014, Salvi 2008) in which the risk of bias was high for several domains including randomisation.[13-15] No relevant, recent systematic reviews were identified.

Sun and colleagues conducted a RCT in which patients attending ED with syncope were randomised to receive either a syncope protocol in an observation unit (n=62) or usual care (n=62).[13] where the maximum stay in the observation unit could not exceed than 24 hours.

In terms of primary outcomes, patients randomised to the intervention spent less time in hospital at the index visit (29 vs. 47 hours p<0.001) and were less likely to be admitted to hospital (RR 0.16 (95% CI 0.09, 0.29) p<0.001). There were no differences in the secondary outcomes of serious events, quality of life (QoL) or satisfaction with care between groups. A reduction in costs was reported but no formal statistical comparison was performed (index visit US$1400 vs. 2420, 30 days US$1800 vs.2520 (2011 data)).

The first of the two nRCT compared usual care with treatment in a 'day hospital' for hyperglycaemic crisis from which the main result was improved readmission rates and associated costs (Benaiges 2014), whilst the second nRCT compared a specialist geriatric ED intervention with a standard ED procedure (Salvi 2008) but without evidence of any differences in outcome and had significant differences in baseline demographic data. [14,15]

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Community hospital (CH) interventions *(Appendix 4)*

Two RCTs were identified describing a community hospital (CH) intervention as an alternative to acute hospital (AH) care[16-19] and no relevant, recent systematic reviews.

Both RCTs were at low risk of bias overall. In the RCT by Vicente, participants were randomised following triage at home to either go to a CH (n=410) or to the ED (n=396).[16] The data presented were limited. The authors reported that the nurse attending the patient at home sent 90 intervention participants to the CH (primary outcome) although six of those individuals were subsequently transferred from the CH to the ED (secondary outcome). There were no formal statistical analyses nor were cost data presented.

The Garåsen RCT compared CH care (n=72) to AH care (n=72) and was published over three separate papers. [17-19] There was no distinction between primary and secondary outcomes. At 26 weeks, there were fewer readmissions in the CH group versus the AH group (19% vs. 36%, p=0.02) and more people receiving no care (25% vs. 10%, p=0.01). At 12 months, there were fewer deaths in the CH group (18% vs. 31%, p=0.03) although the observation period was considerably longer in the CH group (335.7 vs. 292.8 days, p=0.01). Total cost of treatment was less in the CH group compared with those receiving AH care NOK 39,650 ((95% CI kr 30 996-48,304) versus NOK 73,417 (95% CI NOK 52 992-93,843)) data collected 2003-2005 (p = 0.002). Average health services costs per patient/day for the entire observation period was NOK 606 (95% CI £ 450- 761) in the CH group compared to NOK 802 (95% CI NOK 641-962) in the AH group (p = 0.026).

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Hospital-at-Home (HaH) interventions (Appendix 4)

Eight of the HaH studies were focused on specific conditions: heart failure (n=3), chronic obstructive pulmonary disease (n=1), pulmonary embolism (n=1), pneumonia (n=1), stroke (n=1), and uncomplicated diverticulitis (n=1). [20-28] The remaining three HaH studies recruited older participants with a range of conditions, and two of these recruited from residential homes.[29-33] All the specific condition studies were included in recent (2010-2016) systematic reviews [34-40] but no relevant reviews for the older participants with a range of conditions were identified.

Heart failure (HF)

Three RCTs were identified on HaH for HF and their results published in four separate papers.[20-23] These studies were included in two previous reviews of HaH one which focused on HF (Quaddoura 2015).[34,35] This review used the Cochrane risk of bias tool and described the overall quality of the RCTs as modest. The AMSTAR rating of the review highlighted a lack of description of excluded studies and the combination of different QoL measures in meta-analysis.

In the Quaddoura systematic review the patients were randomised to either HaH or AH within the ED and the primary outcomes of the review were hospital readmissions and mortality. HaH increased time to first readmission (mean difference (MD) 14.13 days [95% CI 10.36, 17.91] p=0.015 using data from two RCTs (n=132).[22-23] although there was no strong evidence of an effect on the rate of readmission (RR 0.68 [0.42, 1.09]) using data from two RCTs (n=172).[20,22] This is a sizeable reduction, but consistent with chance in a data set of this size. An improvement was reported in health-related QoL at both 6 and 12 months

(standardized MD (SMD) -0.31 [-0.45 to -0.18]; SMD -0.17 [-0.31 to -0.02] respectively). HaH was comparable to AH care on all-cause mortality (RR 0.94 (0.67, 1.32)) using data from all three RCTs. These studies also showed a significant reduction in costs for the index treatment period (p<0.001). Two trials[20,23] reported lower costs in the HaH group at 12 months, although the difference was not statistically significant in one of the studies.[20] When the authors of this particular review calculated total costs for these two trials, both indicated a cost reduction for HaH compared to AH care.

Chronic obstructive pulmonary disease (COPD)

An RCT by Ricauda was published in 2008 and was also included in two recent systematic reviews - one focusing on COPD and one more generally on HaH.[24,35,36] The high quality COPD review included eight RCTs, one of which described HaH in an early discharge setting, plus the Ricauda trial and six which were published prior to our 2005 inclusion date.

The Ricauda RCT compared HaH (n=52) with AH (n=52) and was conducted with low risk of bias. The primary outcomes were hospital readmission and mortality rates at 6 months. The secondary outcomes included a range of depression, functional, cognitive and nutritional measures as well as costs.

The study showed that there were fewer hospital readmissions for HaH patients compared to AH patients at 6 months (42% vs 87%, p=0.001) although HaH patients had a longer length of stay than those in the AH group (15.5 SD±9.5 vs 11.0 ±SD 7.9 days, p=0.01). Whilst HaH patients experienced improvements in depression and QoL scores during the study, there was no evidence of difference between the two

groups for these outcomes at 6 months. Cumulative mortality at 6 months was comparable between groups (20.2%).

All patients discharged from HaH completed the care programme at home, whereas 11.5% of AH patients continued their care in a long-term facility after hospital discharge, with an average daily cost of $174.7 for a mean period of 25 ±8.7 days. Overall - on a cost per patient per day basis - HaH care was less expensive than that given to the AH group ($101.4 ± 61.3 vs $151.7 ±96.4, p=0.002). This RCT reflected the results of the published systematic review.[36]

Pulmonary embolism

Our review identified one published nRCT of HaH (Rodriguez-Cerillo 2009) for patients with pulmonary embolism which was also included in a recent systematic review with seven other observational studies (Vinson 2012).[25,37] The high quality review concluded that the overall incidence of mortality at 90 days was very low.

The nRCT compared HaH (n=30) with AH (n=31) and was at high risk of bias overall.[25] No distinctions between primary and secondary outcomes were made. Mean length of stay was not statistically different comparing HaH with the AH group (8.9 days (7–14 days) vs. 10.6 days (6–20 days)). No patients treated at home required unexpected return to hospital during admission. There was no major bleeding, thrombosis or death in either group at 90 days in the nRCT. [25] There were no cost data reported.

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Pneumonia

Our review identified one RCT (Carratala 2005) published and included in a recent systematic review (Chalmers 2011) which also described a further five studies comprising a variety of designs).[26,38] The RCT compared HAH (n=110) with AH (n=114) and was at low risk of bias. The primary outcome was the percentage of patients with an 'overall successful outcome' according to seven predefined criteria [26] whilst secondary outcomes were patients' QoL and satisfaction.

An overall successful outcome was achieved in 83.6% of HaH patients and 80.7% of AH patients (absolute difference 2.9% [95% CI, 7.1-12.9]). Subsequent hospital admissions were comparable between groups (6.3 vs. 7.0%). More HaH patients were satisfied with their overall care (91.2 vs. 79.1%; ab 12.1% [CI, 1.8 to 22.5%]). Reported QoL scores were comparable between groups as was the percentage of patients with adverse drug reactions (9.1 vs. 9.6%), medical complications (0.9 vs. 2.6%), and overall mortality (0.9 vs. 0%) for HAH and AH patient groups respectively. There were no cost data presented. This RCT data reflects the result of the systematic review by Chalmers 2011. [38]

Stroke

One RCT on HaH for stroke patients (Kalra 2005) was published and also included in two previous systematic reviews.[27,35,39] This RCT was at low risk of bias. The primary outcome measure was death or institutionalisation at one year. This three-arm study randomised patients into care on a stroke unit (SU) (n=152), care in a general ward (GW) with stroke expert advice (n=152) and HaH with stroke expert advice (n=153) within 72 hours after recruitment in the ED department.

Mortality and institutionalisation at one year were lower in the SU group compared with either the GW (14 vs. 30%, $p < 0.001$) or HaH groups (14 vs. 24%, $p=0.03$). Significantly fewer patients cared for on the SU died compared with those in the GW group (9 vs. 23%, p = 0.001). The SU group showed greater improvement on basic activities of daily living compared with the other two groups (change in Barthel Index 10 vs. 7, $p < 0.002$). QoL at three months was significantly better in SU and HaH patients. There was greater dissatisfaction with care in the GW group compared with SU or HaH groups. The total costs of stroke care per patient over 12 months (data collected 2005-2008) were £11,450 for the SU group, £9527 for GW group and £6840 for HaH group.

Uncomplicated diverticulitis

Our systematic review found one nRCT(Rodriguez-Cerrillo 2013).[28] This study was also included in a recent, moderate quality integrative review on admission-avoidance HaH services.[40] This nRCT compared HaH (n=34) with AH (n=18) for patients with uncomplicated diverticulitis and was, overall, at high risk of bias with no defined primary or secondary outcomes were defined. No statistical detail was provided about any of the data presented. None of the patients treated at home were transferred to the acute hospital. The mean length of stay in the intervention group was 9 days, compared with 10 days in AH. HaH treatment was associated with a cost reduction of €1368 per patient.

Older population with acute medical problems

There were three studies identified published over five papers[29-33] and no relevant recent systematic reviews. One nRCT recruited acutely ill older persons and was published across three separate papers (Leff 2005, main publication).[29-31] This nRCT

compared HaH (n=169) with AH (n=286) with the majority of patients being identified the morning after admission. The study was at high risk of bias.[29] There was no distinction made between primary and secondary outcomes. Patients treated with HaH had a shorter length of stay compared with those given AH care (3.2 vs. 4.9 days, p =0.004). The mean treatment cost was lower for HaH care than for acute hospital care ($5081 vs. $7480, p< 0.001). Eight weeks after admission, there were no differences in the use of health services between HaH and AH patients in terms of ED visits, (0.23 (SD 0.66) 0.22 (SD 0.57)) or readmission (0.28 (SD 0.59) 0.27 (SD 0.55)).

The nRCT by Crilly 2010 recruited elderly nursing home patients presenting at ED but who were willing to receive care back in their nursing home (n=62) and compared these with historical control care home patients who had been hospitalised (n=115). The study was at high risk of bias [32] and no primary outcomes were specified. Intervention participants experienced a longer time in ED than those who had been admitted into hospital (9.94 vs. 7.01 hours p=0.005) but required less time being subsequently cared for (2.19 vs. 6.2 days p<0.001). Overall, the length of an episode of care in days (9.56 (1.26) vs. 6.20 (0.59) days, p=0.14) and the number of readmissions within 28 days (11.3 vs. 11.3, p=0.99) were not statistically different between the two groups. There were no mortality or cost data presented.

The nRCT by Lau 2013 assessed residents of a care home presenting at ED who were subsequently treated back in their care home (n=95) and compared data with historical hospital controls i.e. not from care homes (n=167).[33] No primary outcomes were specified and the study was at high risk of bias. Length of stay was significantly shorter for those in the intervention group compared with the controls (2.0 vs. 11.0

days p<0.001) although mortality (11 (11.6%) vs. 20 (12.0%), p=0.924) and readmission rates (39 (41.1%) vs. 68 (40.7%), p=0.963) at 6 months were comparable between groups. There were no cost data presented.

***Characteristics of those older patients for whom the decision to admit to hospital may be unclear (*Appendix 6)**

Fifteen of the studies included in our systematic review recruited a population with a mean age of more than 75 years, despite the inclusion criterion specifying those over 65 years. Whilst 9/19 studies specifically stated their recruited population was multi-morbid, it is plausible that all the study populations were and so this is very likely to be a factor which impacts on decision-making in acute medical care. Eight studies specified a particular degree of severity for dementia as an inclusion criterion but, in practice, this is a difficult assessment to make in the acute care context. There were inclusion/exclusion criteria in nine of the studies which specified the importance taking account of an individual's home situation, social support networks and coping abilities as part of the decision-making process.

03.05.17

Discussion

Summary of principal findings

The findings of our systematic review show that alternatives to acute hospital care at the point of potential admission for people aged over 65 years can be safe, with comparable mortality and clinical outcomes across a range of acute and chronic conditions. They also have the potential to reduce healthcare spending. The exception to the evidence of benefit of HaH is the treatment of stroke patients, who fare much worse with HaH intervention compared to treatment in a stroke unit. The authors of this study suggest that these differences are due to the overall expertise available in the stroke unit as opposed to care given by generic hospital or homecare staff advised by specialised stroke health professionals. It is recommended therefore that in most cases, in line with current NHS practice for stroke, care should to be provided in specialist units.[41] The key features of older patients for whom the decision to admit may be uncertain are age more than 75 years, co/multi-morbidities, dementia, home situation, social support and individual coping abilities.

Comparison with previous literature

As part of our systematic review, any relevant systematic review published in 2010-2016 was included and referred to when discussing the more recent studies. All of these reviews were on the topic of HaH interventions. In addition to being older evidence, some of the previous reviews in contrast to our own included a number of uncontrolled observational studies. Some also included studies in which HaH interventions were applied in the non-emergency or post-discharge settings. By contrast, our systematic review focuses on bringing together controlled studies on

alternatives to acute hospitalisation at the point of potential admission for the over 65s.

Clinical and research implications

For health professionals, making a decision to admit an older patient can prove very difficult. Decision-making for each individual patient draws upon a range of professional experience and expertise, and should also be influenced by broader factors such as living conditions and individual/family/carer coping, in addition to care preferences. If alternatives to acute admission are available, health professionals must be confident about using these alternative pathways for their patients[5] and whilst many of the interventions in this review may provide viable alternatives to acute care, they may not exist in some healthcare communities or geographical regions. Nevertheless, our review suggests that where established alternatives to admission exist, clinicians should offer these with a degree of confidence and not assume that hospital admission is always the best or safest option for their patient. Future research should aim to provide more comprehensive evidence of both the clinical and cost effectiveness of a wider range of hospital alternatives for a greater range of health issues, as well as exploring in more detail the determinants and outcomes of decision-making under conditions of uncertainty. Many of the studies included in this review recruited highly defined populations and it would be helpful to understand whether the findings can be replicated in more general patient groups. There is also much to be done to improve the collection of data on patient-related outcomes, carer and health professional acceptability, and costs.

Strengths and limitations of review

Our systematic review was conducted to high methodological standards.[42] The majority of evidence presented is based on HaH services, although this includes

treatment of a wide range of conditions. Whilst not all the included studies were randomised or considered to be at low risk of bias, these issues are clearly highlighted and the included studies cover a variety of alternative approaches to hospital admission. The majority of the included studies offer little or no cost data which makes it difficult to assess the cost-effectiveness of any these alternatives to acute hospital care. Whilst writing our protocol we planned to carry out a meta-analysis on suitable data. However, the data we identified were insufficient, in terms of quantity (i.e. often drawn from a single study), quality (i.e. from nRCT) or homogeneity. Where sufficient data were identified - on HaH for heart failure – an analysis had already been conducted within a previous review.[34]

In conclusion, this systematic review describes and assesses evidence on alternatives to acute care for older patients and shows that many of the options available are safe and appear to reduce resource use.

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Competing interests

None of the authors have any competing interests to declare

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Sue Jenkins, lay representative, who co-led a PPI session with MC exploring the relevance of the study findings with a group of older lay representatives including Alma Brooks, Matt Pepper, Joan Pepper, Tom Doyle, and Liz Banks-Jones.

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Authors' contribution

ALH Research Fellow and lead systematic reviewer conducting all stages of the review and responsible for the initial draft of paper.

MC Research Fellow with specific expertise in Patient and Public Involvement (PPI) as well as older age community care. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

AH Senior Research Fellow with specific expertise in patient-related outcomes. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

WH Professor with specific expertise in health economics. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

CM Reader with specific expertise in trial design and statistical analysis. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

JB Professor with specific expertise in emergency care. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

SP Principal Investigator and Professor with specific expertise in primary health care. Third reviewer of data. Commenting and editing on the drafts of the paper.

Data sharing statement

This is a systematic review and all the data we have collected is either in the main text and summary table or in the on-line appendices.

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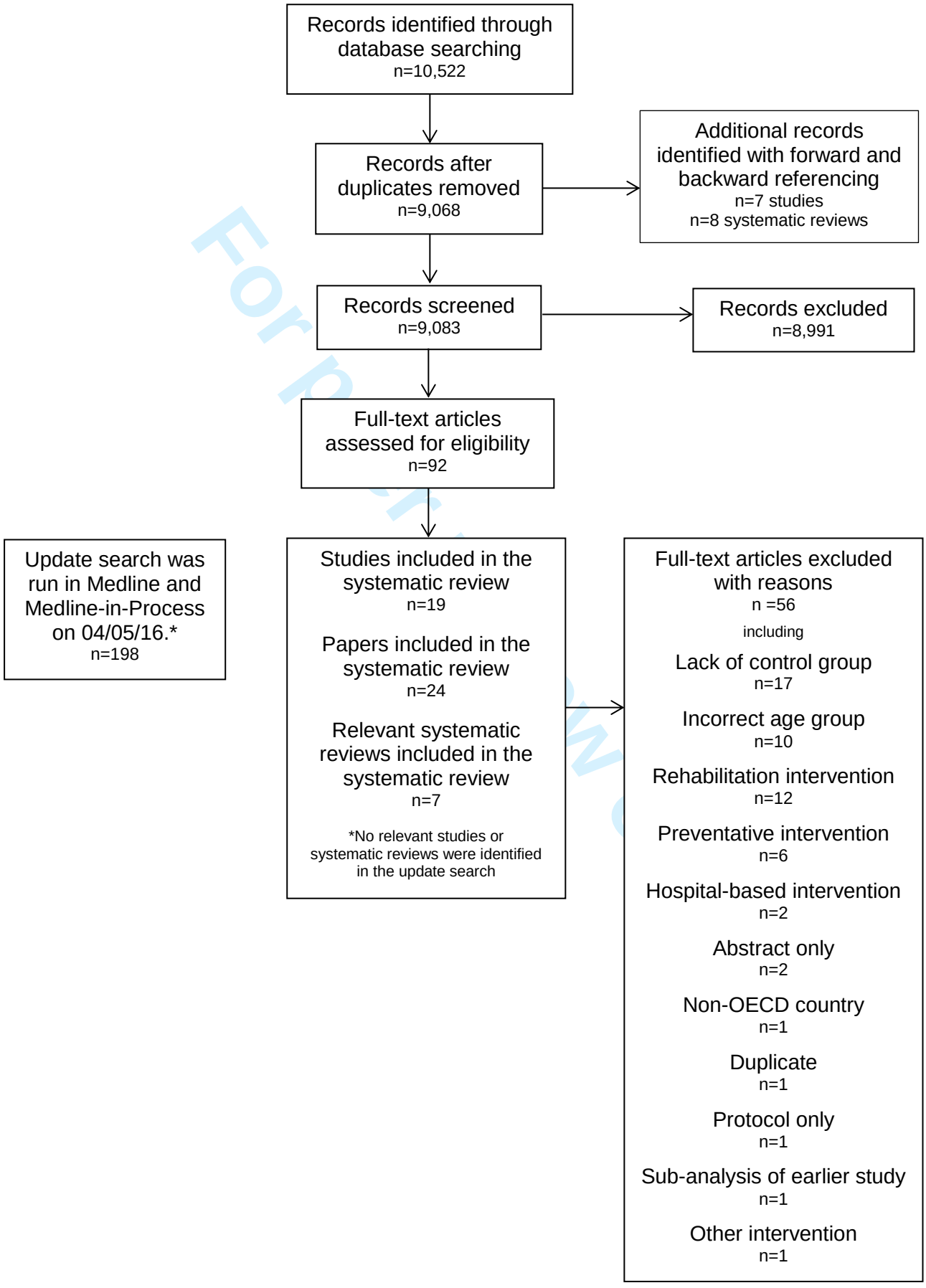
PRISMA flow diagram



Appendix 1: Parent search strategy run in Medline

Database: Medline In-process - current week, Medline 1950 to present

Search Strategy: Run April 24th 2015

1 intervention?ti. or (intervention? adj6 (clinician? or collaborat$ or community or complex or DESIGN$ or doctor? or educational or family doctor? or family physician? or family practitioner? or financial or GP or general practice? or hospital? or impact? or improv$ or individuali?e? or individuali?ing or interdisciplin$ or multicomponent or multi-component or multidisciplin$ or multi-disciplin$ or multifacet$ or multi-facet$ or multimodal$ or multi-modal$ or personali?e? or personali?ing or pharmacies or pharmacist? or pharmacy or physician? or practitioner? or prescrib$ or prescription? or primary care or professional$ or provider? or regulatory or regulatory or tailor$ or target$ or team$ or usual care)).ab. (178760)

2 (pre-intervention? or preintervention? or "pre intervention?" or post-intervention? or postintervention? or "post intervention?").ti,ab. (11719)

3 (hospital$ or patient?).hw. and (study or studies or care or health$ or practitioner? or provider? or physician? or nurse? or nursing or doctor?).ti,hw. (747131)

4 demonstration project?.ti,ab. (2027)

5 (pre-post or "pre test$" or pretest$ or posttest$ or "post test$" or (pre adj5 post)).ti,ab. (72037)

6 (pre-workshop or post-workshop or (before adj3 workshop) or (after adj3 workshop)).ti,ab. (653)

7 trial.ti. or ((study adj3 aim?) or "our study").ab. (697929)

8 (before adj10 (after or during)).ti,ab. (375455)

9 ("quasi-experiment$" or quasiexperiment$ or "quasi random$" or quasirandom$ or "quasi control$" or quasicontrol$ or ((quasi$ or experimental) adj3 (method$ or study or trial or design$))).ti,ab,hw. (107858)

10 ("time series" adj2 interrupt$).ti,ab,hw. (1212)

11 (time points adj3 (over or multiple or three or four or five or six or seven or eight or nine or ten or eleven or twelve or month$ or hour? or day? or "more than")).ab. (10245)

12 pilot.ti. (43282)

13 Pilot projects/ (86631)

14 (clinical trial or controlled clinical trial or multicenter study).pt. (644558)

15 (multicentre or multicenter or multi-centre or multi-center).ti. (31588)

16 random$.ti,ab. or controlled.ti. (809402)

17 (control adj3 (area or cohort? or compare? or condition or design or group? or intervention? or participant? or study)).ab. not (controlled clinical trial or randomized controlled trial).pt. (440969)

18 Aged/ (2394306)

19 "Aged, 80 and over"/ (647729)

20 older adults.mp. (38411)

21 elderly adults.mp. (2417)

22 over 65 years.mp. (3421)

23 virtual ward.mp. (12)

24 intermediate care.mp. (1478)

25 Crisis response.mp. (103)

26 Crisis resolution.mp. (99)

27 reablement.mp. (12)

28 re-ablement.mp. (11)

29 hospital care at home.mp. (14)

30 hospital-at-home.mp. (289)

31 home hospital.mp. (150)

32 medical day hospital care.mp. (2)

33 day hospital.mp. (2435)

34 out-patient facility.mp. (13)

35 Domiciliary care.mp. (247)

36 intermediate services.mp. (7)

37 Intermediate Care Facilities/ (639)

38 Home Care Services, Hospital-Based/ (1662)

39 Home Health Nursing/ (58)

40 Home Nursing/ (8049)

41 admission avoidance.mp. (56)

42 outreach program.mp. (677)

43 hospital outreach.mp. (27)

44 nursing-led units.mp. (3)

45 hospital in home.mp. (8)

46 hospital in the home.mp. (123)

47 medical home care.mp. (39)

48 Crisis intervention service.mp. (31)

49 Geriatric emergency management practice model.mp. (1)

50 day unit.mp. (169)

51 Day Care/ (4670)

52 day centre.mp. (170)

53 comprehensive elderly care.mp. (2)

54 Substitutive care.mp. (1)

55 shared care.mp. (916)

56 guided care.mp. (69)

57 home-based versus hospital-based.mp. (11)

58 home hospitalisation.mp. (28)

59 rapid response team.mp. (515)

60 rapid response nurse.mp. (2)

61 Hospitals, Community/ (10479)

62 *Ambulatory Care/ (15963)

63 *Health Services for the Aged/ (12112)

64 or/1-17 (3278427)

65 or/23-63 (57831)

66 or/18-22 (2428347)

67 64 and 65 and 66 (11288)

68 67 not (child/ or infant/ or adolescent/ or maternal health services/) (9807)

69 68 not (case report/ or case study/ or letter/ or editorial/ or expert opinion.mp.) [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (9192)

70 69 not (Algeria$ or Egypt$ or Liby$ or Morocc$ or Tunisia$ or Western Sahara$ or Angola$ or Benin or Botswana$ or Burkina Faso or Burundi or Cameroon or Cape Verde or Central African Republic or Chad or Comoros or Congo or Djibouti or Eritrea or Ethiopia$ or Gabon or Gambia$ or Ghana or Guinea or Keny$ or Lesotho or Liberia or Madagasca$ or Malawi or Mali or Mauritania or Mauritius or Mayotte or Mozambiq$ or Namibia$ or Niger or Nigeria$ or Reunion or Rwand$ or Saint Helena or Senegal or Seychelles or Sierra Leone or Somalia or South Africa$ or Sudan or Swaziland or Tanzania or Togo or Ugand$ or Zambia$ or Zimbabw$ or China or Chinese or Hong Kong or Macao or Mongolia$ or Taiwan$ or Belarus or Moldov$ or Russia$ or Ukraine or Afghanistan or Armenia$ or Azerbaijan or Bahrain or Cyprus or Cypriot or Georgia$ or Iran$ or Iraq$ or Israel$ or Jordan$ or Kazakhstan or Kuwait or Kyrgyzstan or Leban$ or Oman or Pakistan$ or Palestin$ or Qatar or Saudi Arabia or Syria$ or Tajikistan or Turkmenistan or United Arab Emirates

or Uzbekistan or Yemen or Bangladesh$ or Bhutan or British Indian Ocean Territory or Brunei Darussalam or Cambodia$ or India$ or Indonesia$ or Lao or People's Democratic Republic or Malaysia$ or Maldives or Myanmar or Nepal or Philippin$ or Singapore or Sri Lanka or Thai$ or Timor Leste or Vietnam or Albania$ or Andorra or Bosnia$ or Herzegovina$ or Bulgaria$ or Croatia$ or Estonia or Faroe Islands or Greenland or Liechtenstein or Lithuani$ or Macedonia or Malta or maltese or Romania or Serbia$ or Montenegro or Slovenia or Svalbard or Argentina$ or Belize or Bolivia$ or Brazil$ or chile or Chilean or Colombia$ or Costa Rica$ or Cuba or Ecuador or El Salvador or French Guiana or Guatemala$ or Guyana or Haiti or Honduras or Jamaica$ or Nicaragua$ or Panama or Paraguay or Peru or Puerto Rico or Suriname or Uruguay or Venezuela or developing countr$ or south America$).ti,sh. (8719)

71 admission*.ab. (140603)

72 hospital*.ab. (747796)

73 71 or 72 (804011)

74 70 and 73 (3851)

75 limit 74 to yr="2005 -Current" (1880)

76 remove duplicates from 75 (1829)

Appendix 2: EPOC Risk of bias

Paramedic (PP) / emergency care practitioner (ECP) interventions

Study: Mason 2007 RCT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'We used cluster randomisation to reduce the risk of contamination (practice in the control group being influenced by the presence of the paramedic practitioner in the community) and to allow service level, rather than individual patient level, evaluation of the intervention. Weeks were randomised before the start of the study (to allow for rostering of the paramedic practitioners) to the paramedic practitioner service being active (intervention) or inactive (control), when the standard 999 service was available'
Was allocation adequately concealed?	Low risk	'Episode of care with some form of centralised randomisation scheme'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Flow of patients through trial was presented and intention-to-treat analysis used
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Majority of outcomes were objective but there was one about satisfaction with service i.e. subjective
Was study adequately protected against contamination?	Low risk	'We used cluster randomisation to reduce the risk of contamination (practice in the control group being influenced by the presence of the paramedic practitioner in the community) and to allow service level, rather than individual patient level, evaluation of the intervention'.
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Gray 2008 historical controls - older people with falls

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'From January to April 2006 inclusive, all the patients seen by the ECP service who had rung 999 with a diagnosis of either breathing difficulties or an elderly patient (.65 years of age) with a fall were reviewed.' 'Comparison data were taken from January to April 2005 inclusive for attendances to the same ED for patients with the same criteria as above seen by non-ECP ambulance service personnel'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	Unclear risk	No details given other than 'elderly patients >65yrs with a fall'
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were all objective
Was study adequately protected against contamination?	Low risk	Different data collection time-periods were reported for each group
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Only used half of the study population

Study: Mason 2012 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Potential 'intervention' trust sites were selected on the basis of their heterogeneity of service delivery of ECP care. 'Control' trust sites that did not employ ECPs, but were in close geographical proximity (i.e. within the same or in a neighbouring county) and which offered the same service configurations as the intervention trusts, were then selected'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	High risk	For the care home subgroup, figures were given on selected baseline characteristics but no formal comparison appeared to be made. On face value, clinical characteristics were not balanced e.g. adult medical 30 vs.41%, adult trauma 46 vs.13%
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were all objective
Was study adequately protected against contamination?	Low risk	Intervention and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Emergency Department (ED) interventions

Study: Sun 2014 RCT - syncope

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'Patients were block randomized (n=4) by site in a 1:1 ratio to either the observation protocol or routine inpatient admission'
Was allocation adequately concealed?	Low risk	'A computer generated the study arm assignment at randomization, and no research personnel had advance knowledge of study arm assignment. We could not blind this health service intervention to patients, providers, or research personnel.'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. inpatient admission rates
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Flow chart of participants provided and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were objective but one secondary outcome - participant satisfaction – was subjective
Was study adequately protected against contamination?	Unclear risk	Treatment and control were allocated and delivered in same location so possible for participants to swap allocation
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Salvi 2008 CT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Trained research assistant (VM) screened patients presenting to the ED for Monday to Friday from 9:00 a.m to 6:00 p.m using a standard information sheet explaining the study protocol to patients and proxies'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of initial admissions
Were baseline characteristics similar?	High risk	Intervention and control groups were unbalanced – age, 78.1(7) vs.82.5(7.2) p<0.001, female 47 vs. 68% p=0.004, married 70 vs. 40% p<0.001, SPMSQ 2.5(3.3) vs. 5.2(4.2) p<0.001, ADL4.3(2) vs. 3.2(2.5) p=0.001
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Unclear risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Benaiges 2014 CT - hyperglycaemia

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Patients were assigned to the DH group if they were admitted to hospital within DH opening hours (weekdays from 8:00 a.m to 4:00 p.m); otherwise they were treated in the emergency department and subsequently hospitalized'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of ER visits
Were baseline characteristics similar?	Low risk	Baseline characteristics of treatment and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	'Patients were treated with same protocol for both DH and CH' so contamination was possible
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Community hospital interventions

Study: Vicente 2014 RCT

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'The dispatchers at the EMCC randomized older adults into the study. A sealed envelope randomization procedure was initiated when the dispatcher received the incoming call and identified the participant as an individual aged 65 who resided in the specified geographical area and was assigned a priority level 2 or 3, and the call occurred between 8:00 a.m. and 10:00 p.m'
Was allocation adequately concealed?	Low risk	'The envelope contained the name of the EMS Company 1 or the name of the EMS Company 2. There was an equal chance (1:1) of being assigned to either of the ambulance companies'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of individuals sent direct to community hospital
Were baseline characteristics similar?	High risk	There was a difference in the priority level when ambulance sent out (% individuals) – Level 1) 1.6 vs. 0%, Level 2) 59 vs. 47%, Level 3) 39 vs.53%, p=0.001
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	Separate sealed envelope opened for each individual case
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Garasen 2007/8 ab RCT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'When an eligible patient was identified and accepted for inclusion, a blinded randomisation was performed by the Clinical Research Department using random number tables in blocks to ensure balanced groups'
Was allocation adequately concealed?	Low risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of readmissions for index disease
Were baseline characteristics similar?	Unclear risk	Baseline characteristics of intervention and control groups were described but no formal comparison reported
Were incomplete outcome data adequately addressed?	Unclear	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	Participants were allocated using a clear process but 8 individuals originally assigned to CH were later assigned to GH
Was study free from selective outcome reporting?	Low risk	All outcomes described in methods section were reported in results section plus 12-month data was used in Garasen 2008
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH) interventions: heart failure

Study: Patel 2008 pilot RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Open pilot RCT
Was allocation adequately concealed?	Unclear risk	Used 'random number generator under direction of specialist nurse or hospital admission staff' but no further detail provided
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since majority of outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and small differences seen in gender, education and two particular co-morbidities
Were incomplete outcome data adequately addressed?	High risk	Flow of patients was described although description of analysis was lacking
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Unclear risk	Difficult to understand the description of outcomes in methods section but all were reported in results section
Was study free from other risks of bias?	Unclear risk	Description of analysis and results was possibly too assertive for a feasibility study

Study: Mendoza 2009/Garcia-Soleto 2013 RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'Randomly assigned (1:1) to one of the intervention groups according to an externally generated sequence, which was hidden from the clinicians until the patient had given consent to participate'
Was allocation adequately concealed?	Low risk	As above
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but functional status and health-related QoL were similar
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was described and 'per protocol' analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Tibaldi 2009 RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'By the use of a set of computer-generated random numbers in a 1:1 ratio. The allocation sequence was unknown to any of the investigators and was contained in a set of sealed envelopes, each bearing on the outside only the name of the hospital and a number, which was opened after the acceptance of the patient'
Was allocation adequately concealed?	Low risk	Participants were enrolled within 12-24 hours of ED admission by research assistants, masked to both allocation and hypotheses being tested
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but depression, function and nutrition measures were similar
Were baseline characteristics similar?	Unclear risk	Baseline characteristics of intervention and control groups were reported and heart rate was significantly different p=0.006
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial described and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail available
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH): COPD

Study: Ricauda 2008 RCT - COPD

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Patients were randomised using a set of computer-generated random numbers in a 1:1 ratio.
Was allocation adequately concealed?	Low risk	Allocation sequence was unknown to any of the investigators and kept in a set of sealed envelopes, each bearing on the outside only the name of the hospital and a number. After acceptance of a patient, the ED nurse coordinator, who was not involved in the study, opened the appropriately numbered envelope
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but clinical outcomes e.g. depression were similar
Were baseline characteristics similar?	Low risk	Recorded in DE table
Were incomplete outcome data adequately addressed?	Low risk	Drop outs/loss-to-follow-up were recorded and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	Single-blind study since patients were aware of the treatment assignment although physicians and nurses evaluating patients were blinded to the patient's allocation
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH): Pulmonary embolism

Study: **Rodriguez-Cerillo 2009 nRCT - non-massive pulmonary embolism**

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	nRCT
Was allocation adequately concealed?	High risk	nRCT
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics of treatment and control groups were reported and only difference was prior thromboembolic disease, with these cases all being allocated to hospital
Were incomplete outcome data adequately addressed?	High risk	No patient flow or analysis was described
Was knowledge of allocated interventions adequately prevented during study?	High risk	nRCT
Was study adequately protected against contamination?	Low risk	Clinical decision-making at study entry and any subsequent changes were recorded – although none made in practice
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	High risk	Reported some 'external' decision-making

Hospital-at-Home (HAH): Pneumonia

Study: Carratala 2005 open RCT - pneumonia

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Randomisation was performed by using a computer-generated random code with a block size of 10
Was allocation adequately concealed?	Low risk	Randomisation was stratified by hospital site, and the random code was held centrally, in a sealed envelope, by the clinical epidemiologist. In the emergency department, the infectious disease consultant (in most cases not a study investigator) opened sealed, sequentially numbered opaque envelopes to randomly assign patients who had provided written informed consent and met the study criteria
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Detailed in DE table
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was reported and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	Trial was described as 'unblinded '
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Unclear risk	Lack of blinding in terms of assessment could be problematic

Hospital-at-Home (HAH): Stroke

Study: Kalra 2005 RCT - stroke

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Randomisation was not stratified and was undertaken using the block randomisation technique. This ensured that the number of patients allocated to the stroke unit or to domiciliary services at any one time did not exceed their capacity
Was allocation adequately concealed?	Unclear risk	Randomisation was conducted in blocks of 30 in an office remote from patient treatment areas, so that it would not be possible for those enrolling patients to guess allocation for the vast majority of subjects
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics with regard to stroke type, severity, level of impairment and initial disability were well-matched across the three groups
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was reported and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Unclear risk	Patients were brought to hospital from domiciliary care if that was considered to be clinically appropriate
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	High risk	In order to ensure that participants were treated in the most appropriate setting, swapping of groups was possible

Hospital-at-Home (HAH): Uncomplicated diverticulitis

Study: Rodriguez-Cerrillo 2013 nRCT - uncomplicated diverticulitis

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	nRCT
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Very limited details provided about age, gender and presenting complaint
Were incomplete outcome data adequately addressed?	High risk	No flow of patients was given and only basic analysis reported
Was knowledge of allocated interventions adequately prevented during study?	High risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Unclear risk	Both analysis and reporting of results were limited

Hospital-at-Home (HAH): Mixed population

Study: Leff 2005/2009 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'During the acute care hospital observation phase (1 November 1990 to 30 September 2001), eligible patients were identified and followed through usual hospital care.' During the intervention phase (1 November 2001 to 30 September 2002), eligible patients were identified at the time of admission and were offered the option of receiving their care in hospital-at-home rather than in the acute care hospital'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. time before evaluation
Were baseline characteristics similar?	High risk	Populations differed in measures of poverty, living alone and medication. This was acknowledged but not adjusted for.
Were incomplete outcome data adequately addressed?	Low risk	Intention-to-treat analysis was conducted although there were substantial missing data e.g. in relation to functional status
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective in Leff 2005 (main publication) but Leff 2009 used self-reported i.e. subjective daily activity of living as an outcome
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcomes described in methods section were reported in results section. Whilst there is no mention of activities of daily living in Leff 2005, this outcome was reported in Leff 2009
Was study free from other risks of bias?	Unclear risk	Possible selection bias related to differences in baseline characteristics e.g. functional status

Study: Lau 2003 historical controls

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	Control trial with historical control group
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. palliative care received
Were baseline characteristics similar?	High risk?	There was an imbalance in patient characteristics which may have been due to recruitment bias since the provider was responsible for recruiting patients into the trial. There were more dementia patients treated outside of hospital – although presumably their symptoms were 'fairly mild' since more pronounced behavioural problems were excluded from HaH group
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study name: Crilly 2010 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	Intervention group included 62 Aged Care Facility (ACF) residents who were enrolled in the Hospital in Nursing home programme during the first 12 months that the programme was operational, from 1 July 2003–30 June 2004. All sample members were ACF residents who presented to the ED and were subsequently admitted to hospital
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. palliative care received
Were baseline characteristics similar?	Low risk	Baseline characteristics of the study and control are reported and similar
Were incomplete outcome data adequately addressed?	Unclear	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Appendix 3: AMSTAR ratings of systematic reviews

Study	Was an 'a priori' design provided?	Was there duplicate study selection and data extraction?	Was a comprehensive literature search performed?	Was the status of publication (i.e. grey literature) used as an inclusion criterion?	Was a list of studies (included and excluded) provided?	Were the characteristics of the included studies provided?	Was the scientific quality of the included studies assessed and documented?	Was the scientific quality of the included studies used appropriately in formulating conclusions?	Were the methods used to combine the findings of studies appropriate?	Was the likelihood of publication bias assessed?	Was the conflict of interest included?
Caplan 2012	YES	YES	YES	YES	NO excluded studies not listed	NO studies were grouped by medical, surgical, rehabilitation and psychiatric	YES	YES	YES	YES	YES
Chalmers 2011	YES	YES	YES	NO	NO excluded studies not listed	YES but no ages and no direct reporting of participants in either group	YES but not detailed and whilst Cochrane was cited only one RCT involved	YES	UNCLEAR difficult to judge whether combination of study types is commonly accepted	No	YES
Jeppensen 2012 (Cochrane)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Qaddoura 2015	YES	YES	YES	YES	NO excluded studies not listed	YES	YES	NO relatively high risk of bias but all available data used	NO meta-analysis of two RCTs plus combination of different QoL measures from same study in meta-analysis	NO	YES
Shepperd 2016 (Cochrane)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Varney 2014	YES	NO used single reviewer	YES	YES	NO	YES	YES	NO	N/A no data were combined	NO	YES
Vinson 2012	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Appendix 4: description of interventions included in systematic review

Intervention	Description
Paramedic practitioner (PP) / emergency care practitioner (ECP) interventions	PPs/ECPs can be trained to 'assess and treat' or to refer patients with a range of conditions, as part of pre-hospital care. These roles were created in order to provide a more appropriate response to patients needs in emergency and urgent care settings. Their main purpose is to improve the pathway of care and patient experience, particularly by discharging patients at the scene or by referring on to the most appropriate care practitioner, reducing unnecessary emergency department (ED) attendance and avoidable admissions.
Community hospital (CH) interventions	The role of CHs varies between country and health systems but, essentially, their main role is to provide non-urgent i.e. routine or rehabilitative care. However, their role can be extended to provide an alternative to acute hospital (AH) admission for appropriate cases.
Emergency department (ED) interventions	These involve initial assessment in the ED, followed by an extended stay for tests and observation. This extended stay is in a bed closely associated with the ED, if not part of it.
Hospital-at-home (HaH) interventions	HaH services provide acute or sub-acute treatment in a patient's residence for a condition that would normally require admission to hospital. It is also known as 'hospital in the home' and 'home hospitalisation'.
Hospital in nursing/care home (HNCH) interventions	HNCH is as a model of admission avoidance to treat patients living in nursing and residential care homes, working on the same principles as HaH for community-dwelling residents.

Appendix 5: Detail of included studies

Paramedic/ECP) interventions (n=3)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Mason **2007** **UK**	**Cluster RCT by service** **56 clusters** **Intervention:** paramedic practitioner service n=1469 **Control:** Inactive paramedic practitioner service n=1549	**Inclusion criteria:** Patients aged ≥60yrs recruited from 1 Sep 2003- 26 Sep 2004. Call originated from a Sheffield postcode between 8am-8pm, with a presenting complaint that fell within the scope of practice of the paramedic practitioners. **Exclusion criteria:** **None given** 'If patients were unable to complete questionnaires e.g. because of cognitive impairment or who were unable to read English—we obtained consent for follow-up by review of clinical records only. **Baseline characteristics of participants** Intervention vs. control **Mean age (SD)** 82.6(8.3) vs. 82.5(8.3) yrs **Women %** 72 vs.73% **Living in on own home %** 78vs.78 % **Presenting complaint %** Fall 88 vs.89% Haemorrhage 6 vs.5% Acute medical condition 6vs.5%	A paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner. All identified patients were approached face to face either in the community or in ED for written consent to follow-up. Patients who had more than one eligible episode were recruited only once. The research team independently checked the ambulance service call database at the end of each month for any additional eligible calls not identified These were checked for selection bias but not followed up. Scope of practice of paramedic practitioners: Falls, Lacerations, Epistaxis, Minor burns, Foreign body in ear, nose, or throat, Local anaesthetic techniques, Wound care and suturing techniques, Principles of dressings and splintage, Joint examination, Examination of neurological, cardiovascular, and respiratory system, Examination of ear, nose, and throat, Protocol led dispensing: simple analgesia, antibiotics, tetanus toxoid, Assessment of mobility and social needs, Additional options for referral and requesting investigations, Requests for radiography, Referral processes: emergency department, general practitioner, district nurse, community social services	A paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner in the ED Procedure continued as for intervention	**Relevant measures & outcomes** Primary outcomes ***ED attendance*** ***Hospital admissions within 28 days*** ***Time of call to time of discharge*** ***Patient satisfaction survey including the EQ-5D*** Secondary outcomes ***Subsequent unplanned contact with secondary care at 28 days*** ***Mortality at 28 days***	Intervention vs. control Primary outcomes ***ED attendance (28 days)*** **970 (62.6%) vs. 1286 (87.5%) p<0.001** ***Hospital admissions (28 days)*** **626 (40.4%) vs. 683 (46.5%) p<0.001** ***Mean Time of call (SD) to time of discharge in mins*** **235.1(183.3) vs. 277.8(182.6) p<0.001** ***Patient satisfaction survey including the EQ-5D*** **Very satisfied with care 656 (85.5%)vs.528 (73.8%) p<0.001** Secondary outcomes ***Subsequent unplanned contact with secondary care*** **330(21.3%) vs. 259 (17.6%) p<0.01** ***Mortality at 28days*** 68(4.4%) vs.74(5%) p=0.41

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Gray **2008** **UK**	**COS with historical controls** **Intervention:** Emergency care practitioner **(ECP)** intervention n=233 **Control:** Historical control group from ED n=772	The study included two groups of patients a) those with breathing difficulties & b) elderly patients >65yrs with a fall. The latter only is reported here. **Inclusion criteria:** Elderly patients >65yrs with a fall. **Exclusion criteria:** None given **Baseline characteristics of participants** None given	**Outline of intervention** Jan-April 2006 inclusive, all the patients seen by the ECP service who had rung 999 and were an elderly patient (>65yrs) with a fall were reviewed. Each patient seen by an ECP was searched for in the hospital records for ED attendance or admissions in 72 h and 28 days following attendance by an ECP	**Outline of control** Comparison data taken Jan- April 2005 inclusive for attendances to same ED for patients with the same criteria as above & seen by non-ECP ambulance service personnel. These dates were chosen because, during this time, the ECP service was not tasked to patients with breathing difficulties and Yorkshire Ambulance Service had only 12 operational ECPs during this comparison period compared with 24 whole-time equivalent operational ECPs during the study period	**Relevant measures & outcomes** Outcome on initial contact: ***Treated at and stayed home*** ***ED and or admitted*** At 72hrs & 28 days ***At home*** ***ED attendance*** ***Admission*** **Costs** None	**ECP vs. ED** Outcome on initial contact: ***Stayed at home (PC referral)/went home*** 171 vs. 369 (73% vs. 48% avoidable admission rate) **At 72hr:** 21/171 (intervention grp) attended ED and or were admitted **At 28 days:** A further 19 (intervention grp) attended ED and or were admitted Avoidable admission rate (intervention grp) at 28 days was 56% (17% better) compared to control group p<0.05

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Mason **2012** **UK**	**COS** **Intervention:** Five teams of Emergency Care Practitioners (ECP) n= 256 for care home cohort **Control:** Five usual care providers n=201 for care home cohort	**Inclusion criteria:** Informed consent was obtained from all study participants prior to recruitment. Within each pair of services all patients presenting with emergency or urgent complaints that were eligible to be seen by ECPs and presented to either the intervention or the control services between May 2006 and August 2007 were included in the trial. **Exclusion criteria:** No detail **Baseline characteristics of participants** (no stats given) Care home cohort Intervention vs. control **Mean age** 83.5(10.40 vs. 84.5(8.5) yrs **% Female** 68 vs.66% **Clinical complaint %** Adult medical 30 vs.41 % Adult trauma 46 vs.13 % Elderly falls 23vs.46%	**Outline of intervention** No detail	**Outline of control** No detail	**Relevant measures & outcomes** Using paired services Primary outcomes ***% of patients Discharged following consultation with no further follow up by any health professional*** ***Urgently referred to hospital (both ED or direct admission)*** ***Non-urgently referred to GP or community care*** Secondary outcomes (relevant ones only) ***Episode time from first contact to discharge***	***Discharged with no further follow up by any health professional*** 49.2 vs.12.4% MD 36.8% (95% CI 26.7,46.8) ***Urgently referred to hospital (both ED or direct admission)*** 22.7 vs. 87.6% MD -64.9% (95% CI -71.8 ,.-58.0) ***Non-urgently referred to GP or community care*** 28.1vs. 0% 28.1% (22.6,33.7) ***Episode time from first contact to discharge median in mins (IQR)*** 60 (40,80) vs. 39 (29,58) Time ratio 1.36 (1.24,1.49)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Sun **2014** **USA**	**RCT** **Intervention:** ED observation syncope protocol n=62 **Control:** Normal In-patient admission n=62	**Inclusion criteria:** Patients aged≥ 50 years or older diagnosed with intermediate syncope. **Exclusion criteria** Patients with a serious condition: symptomatic arrhythmias, myocardial infarction, pulmonary embolism, acute pulmonary edema, stroke, severe anaemia or blood loss requiring blood transfusion, sepsis, and major traumatic injury. Also: seizure, head trauma, or intoxication as reason for loss of consciousness; new/ baseline cognitive impairment; do-not-resuscitate or do-not-intubate status; active chemotherapy and inability to speak either English/Spanish. Met high risk criteria. **Baseline characteristics of participants** Observation vs. control Mean(SD) or% **Mean age** 65 (11) vs. 64(11) **% Female** 53 vs. 48 **Syncope index complaint (vs near syncope)** 74vs. 61% **Congestive heart failure** 2vs. 3% **Coronary artery disease** 13vs.8% **Arrhythmia** 8vs.6% **Syncope in previous yr** 16vs.21% **Quality of well-being scale** 0.55(0.15) vs. 0.55(0.14) **Syncope functional status** 29((25) vs.25(26) **Syncope risk score** 0.76 (0.840 vs.0.76 (0.67)	**Outline of intervention** Patients received continuous cardiac monitoring ≥ 12hrs. ≤2 serial cardiac troponin tests approx. 6 hours apart to exclude acute MI. Rest echocardiogram for patients with cardiac murmur, if not performed in previous 6mths. Additional testing as required. Maximum stay in observation unit could not be more than 24hrs. Observation protocol patients who received a diagnosis detailed in exclusion list or had pending tests at 24hrs were admitted **High Risk Criteria** Serious condition identified in the ED, History of ventricular arrhythmia, Cardiac device with dysfunction, Exertional syncope, Presentation concerning for acute coronary syndrome, Severe cardiac valve disease (e.g., aortic stenosis <1 cm2), Known cardiac ejection faction <40% Electrocardiogram findings of QTc>500 mS,pre-excitation, non-sustained ventricular tachycardia, Emergency physician judgment **Intermediate Risk Criteria** No high risk features **AND** No low risk features **AND** Clinical judgment by emergency physician that patient requires further diagnostic evaluation **Low Risk** Symptoms consistent with orthostatic or vasovagal syncope**,** Emergency physician judgment that no further diagnostic evaluation is needed.	**Outline of control** The syncope protocol was not used. Contamination between groups was minimized by being managed in distinct physical spaces by different clinical services. **Intervention delivered by:** No detail	**Relevant measures & outcomes** Primary outcomes ***Inpatient admission rates*** ***Hospital LOS at indexed visit*** Secondary outcomes ***30 day and 6mth serious events*** ***Index and 30 day hospital costs*** ***30 days changes in QoL*** ***30 day patient satisfaction***	***Observation vs. s care*** ***Inpatient admission rates*** **9 (15%) vs. 57 (92%)** **Relative rate 0.16 (95%CI 0.09,0.29, p<0.001)** ***Hospital LOS at indexed visit*** **mean SD (hrs) 29 (15) vs. 47hrs (34) (p<0.001)** ***Serious events*** ***During hospital visit*** Death 0 vs. 0 Arrhythmia 2 vs. 2 Pacemaker insertion 1vs.1 Syncope with bone fracture 2 vs.1 30 days recurrent syncope 1 vs 1 30 day serious outcomes after discharge 2 vs. 0 6mth serious outcomes after hospital discharge 4 vs.5 ***Costs $ (SD)*** At index visit 1,400(1,220) vs.2,420(3,930) Within 30 days 1,800(2,150) vs.2,520(3,980) ***Change in quality of life*** mean SD 0 (0.2) vs. 0.03 (0.18) ***Change in syncope functional status*** -7.6(20.1) vs.-2.4(26.3) ***Patient satisfaction*** 8.9(1.40 vs.9.3(0.9)

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Benaiges **2014** **Spain**	**COS** **Intervention:** 'Day hospital' (DH) n=64 **Control:** Conventional hospitalisation (CH) n=36	**Inclusion criteria:** Patients with sustained hyperglycemia (>300 mg/dL) for at least 3 days with or without ketosis **Exclusion criteria** Ketoacidosis (venous pH <7.31 and/or HCO3 <22 mEq), hyperosmolar crisis (glycemia >600 mg/dL and effective plasma osmolarity >320 mOsm/L), unstable hemodynamic status or need for ventilatory support, severe precipitating factors such as acute myocardial infarction, stroke, sepsis, social deprivation, and dependence for four or more activities of daily living (Katz index >D). **Baseline characteristics of participants** **(Stats shown if signif)** DH vs.CH **Age** 80.3(4.8)vs. 80.6(4.6)yrs **Female** 67 vs. 56% **BMI** 26.1(4.9)vs.25.5(5.1) **Katz A&B** 72.2vs.72.2% **Charlson Index** 3.2(2.0)vs. 3.3(1.7) **Family support** 88.1 vs.97.1% **Diabetes duration** 14.4 (8.0) vs. 97.1 yrs Plus other specific diabetes measures	**Outline of intervention** Patients assigned to DH if admitted to hospital within DH opening hours (week days 8 am -4 pm); otherwise they were treated in ED and subsequently hospitalized. After initial treatment of hyperglycemic crisis DH patients were scheduled for follow-up visits at 24, 72 hours, and 7 days to adjust treatment and to complete their diabetes education Patients were treated with same protocol for both DH and CH: this included initial evaluation with a blood test, urinalysis, chest radiograph to rule out underlying infectious disease, and hourly measurement of glycemia and ketonemia. Treatment included hydration as required, an insulin regimen with insulin, and oral carbohydrate intake if glucose levels were less than 250 mg/dL with persistent ketosis. If infection was diagnosed, treatment was initiated. Diabetes education was delivered by specialist diabetes nurse with specific attention paid to dietary advice, physical activity, and recognition of hypoglycemia. Measurement of glycated hemoglobin (HbA1c) and clinical evaluation was scheduled for 3 & 6 mths for patients in both groups	**Outline of control** At hospital discharge, CH patients were scheduled for a one-week follow-up visit in outpatient clinic. **Intervention delivered by:** Unclear but normal outpatient staff	**Relevant measures & outcomes** (no distinguishing between primary and secondary outcomes) At 3 mth follow up ***[No. of mild or severe hypoglycemic episodes]*** ***Readmissions for diabetes or unrelated cause*** ***[Nosocomial complications]*** ***No. of outpatient visits*** ***No. of ER visits*** [outcomes] not detailed as not relevant to our question ***Costs*** ***Initial care*** ***Complementary examinations*** ***Pharmacy*** ***Outpatient visits*** ***Readmissions*** ***Total*** In euros	Mean (SD) DH vs.CH **Readmissions for diabetes (%)** **1(1.6)vs. 5 (13.9)** **P=0.04** Readmission for any cause (%) 4(6.3)vs.7(19.4) p=0.085 **No. of outpatient visits (SE?)** **5.0(2.2)vs. 2.5(2.0)** **p=0.012** No. of ER visits (SE?)? 0.2(0.6)vs.0.2(0.4) P=0.59 **Costs** **Initial care** **580.2(489.1) vs. 2,013.6(790.4) p<0.001** **Complementary examinations** **123.7(276.3) vs. 281.3(188.1) p=0.007** Pharmacy 12.8(95.6)vs. 20.3(24.8) P=0.676 Outpatient visits **116.7(75.3) vs. 56.9(105.7) p=0.003** **Readmissions (total)** **340.8(1190)vs.288.3(916.8)p=0.835** **Total** **1,345.1(793.6) vs. 2,212.4(982.5) p<0.001**

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Salvi **2008** **Italy**	**COS** **(secondary analysis)** **Intervention:** Geriatric ED (GED) n=100 **Control:** Conventional ED (CED) n=100	**Inclusion criteria:** Patients aged ≥ 65yrs were enrolled in June 2006 from the GED and July 2006 from the CED taking care that none presenting to the ED in the course of the study period was recruited again. **Exclusion criteria** Cognitive impairment (a score of ≥5 on the Short Portable Mental Status Questionnaire SPMSQ) and no proxy, Those too ill to respond, Trauma patients **Baseline characteristics of participants** CED vs GED Mean(SD) **Age 78.1(7) vs.82.5(7.20 p<0.001** **Female 47 vs. 68% p<0.001** **Married 70 vs. 40% p<0.001** Living alone 12 vs 14 **Triage code** Urgent/semi-urgent (2/3) 97 vs.90 % Charlson Index 3.3(2.3) vs. 3.4(1.7) **SPMSQ** **2.5(3.3) vs. 5.2(4.2) p<0.001** **ADL4.3(2) vs. 3.2(2.5)** **P=0.001** No differences in profile of diagnosis in ED between groups	**Outline of intervention** No details beyond ED plus observation unit of 6 beds **Intervention delivered by:** No details	**Outline of control** Patients presenting to ED were screened Mon-Fri 9am- 6pm using standard information sheet. Interviews conducted with patients or family member/other for patients with cognitive impairment. Written consent & access to medical records was obtained. patients a underwent a brief geriatric assessment using the Charlson Index, SPMSQ, and ADL before the current event	**Relevant measures & outcomes** ***Mean duration (SD)*** ***No. of initial admissions*** ***LOS in hospital days*** ***Both of above presented as baseline data*** ***No. ED visits at 30 days and 6 mths*** ***Frequent ED return (≥3 visits over 6 mths)*** ***No. hospital admissions at 6mths*** ***ADL at 6mths (defined as functional decline*** ***Mortality at 30 days & 6 mths*** **Costs** None	CED vs. GED ***Mean duration (SD)*** **6.2(4.5) hrs vs. 12.8 (8.5) hrs** **P<0.001** ***No. of initial admissions*** 53 vs.63 p=0.2 ***LOS in days*** 10(6.65) vs. 10.5(7.2) p=0.74 ***No. ED visits*** 30 days 25 vs. 23 visits p=0.88 6months 51 vs. 42 p=0.25 ***Frequent ED return (≥3 visits over 6 mths)*** 11 vs.13 visits p=0.84 ***No. hospital admissions at 6mths*** 36 vs.29 p=0.2 ***ADL*** 20 vs. 20 p=0.34 ***Mortality*** **30 days 8 vs. 5 deaths** **6months 20 vs. 19** Statistically significant at 6mths after adjustment for age, sex, living status, admission at time of recruitment Charlson index, SPMSQ and ADL **p=0.047**

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Garåsen **2007/8ab** **Norway**	**RCT** **Intervention:** Community hospital (CH) n=72 assigned but 8 went on to GH **Control:** General hospital (GH)admission n=70	**Inclusion criteria:** Patients aged ≥60 years admitted to general hospital due to acute illness or acute exacerbation of known chronic disease Probably in need of in ward care for ≥ 3-4 days Admitted from own homes and expected to return home when care finished. **Exclusion criteria** Severe dementia or a psychiatric disorders needing specialised care 24 hours a day. **Baseline characteristics of participants** **(No stats given)** [including data from n=8 who were assigned CH then went to GH] CH vs.GH **Age** 80.6 (0.8)vs. 81.3(0.8)yrs **Female** 72 vs.61% **Living with spouse** 16 vs. 15 **ADL (SD)** 2.24(0.9) vs. 2.05 (0.7) **Primary diagnosis** **Cardio dis** 31 vs.29% **Infect** 18vs. 23% **Fractures/contusions** 19vs. 17% **Pulmonary disease** 7vs.9% **Neurological** 7 vs.6% **Cancer** 3 vs 6% **Psychiatric** 1vs.0% **Other** 14 vs 11%	**Outline of intervention** On admission to CH the physicians performed a medical examination of the patients and a careful evaluation of available earlier health records from the **admitting general practitioner, the general hospital physicians and the community home care services**. The communication with each patient and his family focusing on physical and mental challenges was also essential to understand the needs and level of care. . Assume from the inclusion criteria that all patients came to the general hospital initially then ' When an eligible patient was identified and accepted for inclusion, a blinded randomisation was performed by the Clinical Research Department at the Faculty of Medicine.' All patients randomised for care at the community hospital were transferred from the general hospital within 24 hours after the time of inclusion to the study and immediately after the time of randomisation.	**Outline of control** The care at different departments at GH and communication with primary health care followed the standard routines through the formal organisation.	**Relevant measures & outcomes** Follow up at 26 weeks & 12 months ***No. of readmission for index disease*** ***Need for community home care*** ***Need for long term nursing home*** ***No. of days in institutions after randomisation [intervention +rehab +readmissions] data is available for separate services*** ***No. of deaths*** ***No. of days before death*** ***No care*** 12 month data in [0273] **Costs** None	CH vs. GH No. (%) At 26 weeks ***No. of readmission for index disease*** **14(19%) vs. 25 (36%) p=0.02** ***Need for community home care*** 38(53%) vs. 44(63%) p=0.37 ***Need for long term nursing home*** 7(10%) vs. 5(7%) p= 0.76 ***No. days in institutions*** 31(95% CI 26.1,34.7) vs.29.8 (95% CI 23.2,36.4) p=0.80 ***No. of deaths*** 9(12.5%) vs14(20%) p=0.15 **No. days before death** 165 (95% CI 154-176) vs. 156 (95% CI 144,165) **No care** **18(25%) vs. 7(10%) p=0.01** 12 month data **No. of deaths** **13(18.1%) vs. 22 (31.4%) p=0.03** **Total observation period** **335.7(95% CI 312.0,359.4) vs. 292.8(95%CI 264.1,321.5) days p=0.01**

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Vicente 2014 **Sweden**	**RCT** **Intervention:** Going to a community-based hospital n=410 **Control:** Going to ED n=396 .	**Inclusion criteria:** No specific information **Exclusion criteria:** No specific information older adults were randomized when they called the emergency number **Baseline characteristics of participants** Intervention vs. control **Mean age (SD)** 81 (8) vs. 81(8) yrs **% Female** 56 vs. 59% **Priority level when ambulance sent out (% individuals)** **1. 1.6 vs. 0%** **2. 59 vs. 47 %** **3. 39 vs.53%** **P=0.001** **Priority level when ambulance arrives at hospital (% individuals)** 1. 7.2 vs.3.6% 2. 39 vs.35% 3.54 vs.61%	**Outline of intervention** The study was conducted over 14 months from Oct 2008 to Dec 2009. Two EMS companies were included in the study. Ambulance personnel at Company 1 had training in and access to the system and tool and could triage eligible individuals to a GW or, a CECC at a CH. By following system and tool & after assessment of the individual's medical situation and care needs, the ambulance nurse was able to decide whether the individual required full ED services or would benefit more from being transported to an assessment at the CH instead. **Delivered by:** The ambulance nurse education are required to have a course of 60 credits includes ≥ 30 credits in Caring Science. The criterion for entering this program is a BSc Caring Science and Nursing. Since 2007, a 1-year Master's Degree & postgraduate Diploma in Specialist Nursing, Prehospital Emergency Care Program has been available.	**Outline of control** Ambulance personnel at Company 2 had no training in the system and tool, and transported all individuals to a full-service ED at a tertiary hospital	**Relevant measures & outcomes** Primary outcome: ***No. of individuals sent direct to CH for either to GW or CECC*** *Secondary outcome:* ***No. of subsequent transfers from CH to ED within 24 hrs*** Calculated as Intention to treat (ITT) and per protocol (pp) analysis **Costs** None	Intervention vs. control ***No. of individuals sent direct to CH for either to GW or CECC*** ITT 90/449 20% (16.6,24) PP 56/273 20.5% (16.1,25.7) ***No. of subsequent transfers from CH to ED within 24 hrs*** ITT 6/90 6.7% (3.1,13.8) PP 4/56 7.1 (2.8,17.0)

Hospital at home for community dwelling older people (n=9)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Patel 2008 **Sweden** **Heart Failure**	**pilot RCT** **Intervention:** HC Treated at home after >48hrs treatment in ED (n=13) **Control:** CC Treated in hospital as per hospital treatment guidelines (n=18)	**Inclusion criteria:** *Into study* Earlier diagnosed with CHF with diastolic or systolic LVD Deterioration of HF ≥3 days with symptoms of increasing dyspnoea, orthopnoea, weight gain≥2 kg, debuting peripheral oedema or abdominal swelling Clinical signs, e.g., extended jugular vein, leg oedema, tachypnoea, pulmonary rales, ascites and third heart sound. At least one symptom and one sign should be present New York Heart Association class II–IV *for home treatment* It was considered medically safe to treat patients at home if they had a S-Potassium level 3.4-5.5 mmol/L, systolic blood pressure >95 mm Hg, S Creatinine<250 µmol/L & <50% increase from the baseline value during drug adjustment. **Exclusion criteria** Unwillingness to participate Worsening of CHF<3 days Newly onset HF, Pulmonary or pre-pulmonary oedema, Need for monitoring of arrhythmia Other morbidities indicating need for hospitalisation. Living at an institution. Inability to follow instructionsS-Haemoglobinb100 g/L or a decrease of S Haemoglobin>20 g/L S-Creatinine>250 µmol/L S-Potassium>5.5 mmol/L or b3.4 mmol/L S-Troponin T>0.05 µg/L Creatine kinase-MB>5 µg/L ASAT and ALAT>three times above the normal value. Systolic blood pressure>95 mm Hg Heart rate<45 or >110 beats/min **Baseline characteristics of participants** Male n (%) 6 (46)/7 (54) 15 (83)/3 (17) 0.03 Age (years) mean (SD) 77 (10) 78 (8) ns Marital status n (%) Divorced 2 (15) 3 (17) ns Single 1 (8) 2 (11) ns Widowed 7 (54) 5 (28) ns Education n (%) ≥9 years 1 (8) 8 (44) 0.02 ns Weight kg mean (SD) 71 (13) 79 (15) ns NT-proBNP pg/ml (median and interquartile range) 4420 (1690–14350) 9335 (3375–13350) ns LVEF % mean (SD) 36 (13) 33 (12) Preserved ejection fraction CHF n (%) 3 (23) 2 (11) Systolic CHF n (%) 10 (77) 16 (89) NYHA class n (%)II 1 (5.5)III 13 (100) 16 (89) IV 1 (5.5) truncated	**Outline of intervention** Initially treated in the ED for ≥48 h & then sent home. The specialist HF nurses followed a written physician directed care plan including adjusting medications. A cardiologist could be consulted. All patients followed-up one day after returning home by nurse. The patients were visited daily or every other day for 5–7 days as appropriate. The home visits stopped when: (1) was symptomatically stable or improving, (2) had stable or falling weight, (3) had no signs of pulmonary rales and (4) had no oedema above the ankle. Patients could contact nurse by phone in office hours. Nurses at intensive cardiac care unit could be reached by telephone after office hours. A cardiologist was always available for phone consultation ≤1 month after the last home visit, the nurse was available for phone counselling.	**Outline of control** Treated in hospital as per hospital treatment guidelines	**Relevant measures & outcomes** No distinction between primary and secondary outcomes **Clinical status** was documented at 1,4,8& 12 mths **Direct costs** for control group based on compensation paid to hospital and for home care group based on time & activities of nurses & physicians plus lab tests and i.v diuretic episodes **Readmissions** from hospital data (presumably up to 12mths – not listed in methods)	There was no significant difference in clinical events including readmissions adverse events or in HRQL (measured at baseline too). The total cost related to CHF was lower in the HC group after 12 months (p=0.05) detail of costs Euros HC vs. CC Nurse cost 386 (244-1107) vs. N/A Physician 35(19-74) vs. N/A Transport 96953-127) vs. N/A Total cost for care 586 (334-1125) vs. 3277 (2125-5750) Readmissions 0.5(0.8) vs. 0.6 (0.8) ns

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Mendoza 2009 Garcia-Soleto 2013 **Spain** **Heart Failure**	**RCT** **Intervention:** Hospital at home (HAH) care (n=37) **Control:** Inpatient hospital care (IHC) in a cardiology unit (n=34)	**Inclusion criteria:** Patient of 65 years and over With diagnosis and prognosis evaluation of HF since at least 12 months prior to the study NYHA functional class II or III before coming to ED due to exacerbation **Exclusion criteria** Admitted in the preceding 2 months for deterioration of HF or acute coronary syndrome Presence of severe symptoms such as sudden worsening of HF Poor prognosis factors (haemodynamic instability, severe arrhythmia, baseline creatinine above 2.5 mg/dL) No response to treatment in the ED Active cancer, severe dementia, or any other disease at an advanced stage indicating life expectancy of less than 6 months Acute psychiatric diseases, active alcoholism Active pulmonary tuberculosis Those living in a psycho-geriatric institution No guarantee of all-day supervision Absence of a telephone at home or living more than 10 km from the hospital **Baseline characteristics of participants IHC vs. HaH** Women, n (%) 10 (29.4) 19 (51.4) 0.06 Age, mean +SD 79.9+6.3 78.1+6.2 0.20 Admissions for HF in previous year 0.41+0.86 0.65+0.86 0.13 O2 saturation in ED 91.4+5.2 93.2+4.6 0.12 Functional Class NYHA II, n (%) 23 (67.6) 19 (51.4) Functional Class NYHA III, n (%) 11 (32.4) 18 (48.6) 0.16 Atrial fibrillation, n (%) 16 (47) 21 (56.8) 0.49 LVEF ≥45%, n (%) 24 (70) 23 (62.1) LVEF , <45%, n (%) 10 (29.4) 14 (37.8) 0.13 NT-proBNP (pg/mL) 4056+5352 3864+3720 0.86 Charlson index 2.1+1.3 2.5+1.5 0.35	**Outline of intervention** Characteristics of the HaH unit explained whilst still in ED. Given information sheet with contact phone numbers. Within 12–24 h of the ED visit, patients received scheduled & if necessary, urgent visits to their homes from an internal medicine specialist & a nurse, (staff of the HaH unit). If deterioration occurred outside the working hours (8am-9 pm every day of yr), patients & family were instructed to call 112 to explain they were HaH patients. Samples were taken for lab tests and ECGs were performed in patient's home X-ray & echocardiography at hospital was as accessible for HaH patients as for in-patients. Generally all patients were visited daily by a specialist nurse. Patients were visited by a physician daily or every other day depending on condition. Treatment in HaH finished with referral to primary care after recovery or, in case of deterioration or no response to treatment, with transfer to the cardiology ward.	**Outline of control** Patients were admitted to hospital, cardiology ward & were managed by the usual staff of cardiology specialists and nurses, in accordance with guidelines.	**Relevant measures & outcomes** No distinction between primary and secondary outcomes ***Effectiveness*** Necessity to transfer the patient from HaH to IHC during the first admission Mortality due to any cause, re-admission due to HF, or another cardiovascular event (stroke, acute coronary syndrome, and coronary revascularization) during 1 year of follow-up. Functional status -Barthel index Health-related quality of life -SF-36 since first admission up to 12 months later ***Costs*** Cost of the stay Medication, diagnostic tests (electrocardiography, echocardiography, laboratory tests, and chest X-ray), consumables, and transport. visits to HF clinic, primary care physician or ED, as well as re-admissions. For re-hospitalizations, the cost of the admission was estimated as the average cost per day incurred during the first admission for each group.	Clinical outcomes were similar after initial admission and also after the 12 months of follow-up. Death or re-admission due to HF or a cardiovascular event occurred in 19 patients in IHC and 20 in HaH (P=0.88). Changes in functional status and health-related quality of life over the follow-up period were not significantly different. Average cost of initial admission 4502±2153E in IHC and 2541±1334E in HaH (P< 0.001). During 12 months of follow-up, the average expenditure was 4619+7679E and 3425+4948E (P= 0.83) respectively.

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Tibaldi 2009 Italy **Heart Failure**	**single blind RCT** **Intervention:** Physician led - Geriatric Home Hospitalization Service (GHHS; n=48) **Control:** Patients were randomly assigned to the general medical ward (GMW; n=53)	**Inclusion criteria:** ≥75 years with a pre-existing diagnosis of CHF (stage C AHA) & persistent functional impairment indicative of NYHA class III or IV status presenting at hospital ED for acute decompensation (defined)& in need of hospital care. Additional inclusion criteria were appropriate care supervision at home, telephone connection, living in the hospital at- home catchment area, informed consent, at least 1 previous admission for acute CHF, and need for intravenous drug infusion. **Exclusion criteria** New-onset heart failure; absence of family and social support; need for mechanical ventilation, hemodialysis, or intensive monitoring; severe dementia ; terminal malignant neoplasm; severe renal impairment; hepatic failure; serum hemoglobin level less than 9 g/dL; and planned cardiac surgery(eg, valve replacement). **Baseline characteristics of participants** Long list of demographic & clinical baseline – truncated GHHS vs. GMV Mean age 82.2 (5.2) vs. 80.1(4.9) p=0.04 Male (%) 22(46) vs. 30 (57) Married (%) 22 (46) vs. 24 (45) Family support at home (%) 48(100) vs. 53(100) Length of disease (yr) 5.4 (4.7) vs. 5.2 (4.7) plus clinical symptoms both cardiovascular & general including functional status (Barthel index) depression (GDS) MMSE, MNA, comorbidity measured by CIRS 3.6 (1) vs. 3.4 (2) All ns except age	**Outline of intervention** The team has 7 cars, is multidisciplinary and consists: 4 geriatricians, 13 nurses, 3 physio-therapists, 1 social worker &1 counselor working together as a team, with daily meetings 7 days a week. In ED all necessary diagnostic tests are provided and then the patient moves home by ambulance, usually within a few hours. Medical consultation with other hospital specialists is possible in the hospital or at the home of the patient. Treatments included physician and nurse visits, standard blood tests, pulse oximetry, spirometry, electrocardiography, echocardiography etc (as per hospital) Patients treated at home and family members obtained adequate Education e.g. early recognition of symptoms. Protocols for prevention of nosocomial infections, bed sores, and immobilization are routinely adopted for frail elderly inpatients. In the first days after admission to GHHS patient was visited at home on a daily basis by physicians and nurses. In the following days this care is tapered off as appropriate Consultation with cardiologists or other hospital specialists was possible. Physicians and nurses were available at all times for urgent home visits.	**Outline of control** The inpatient control group (GMW) received routine hospital care. Protocols for prevention of nosocomial infections, bed sores, and immobilization are routinely adopted for frail elderly inpatients.	**Relevant measures & outcomes** ***Primary outcome*** Mortality at 6 months. ***Secondary outcomes*** morbidity (infections, delirium, bed sores, deep vein thrombosis, and falls) during hospitalization, admissions to a nursing home, and subsequent hospital admissions related to any cause	***Primary outcomes*** Patient mortality at 6 months was 15% in the total sample, without significant differences between the 2 settings of care. (7 vs. 8 deaths) ***Secondary outcomes*** The number of subsequent hospital admissions was not statistically different in the 2 groups 8 (17%) vs. 18 (34%) mean (SD) time to first additional admission was longer for the GHHS patients (84.3 [22.2] days vs 69.8[36.2] days, *P*=.02). Only the GHHS patients experienced improvements in Depression (GDS) +1.48 (1.860 vs. +0.12 (3.36) p=0.02) nutritional status (MNA) -0.86(1.12) vs. -0.27 (1.78) p=0.05 Quality-of-life(NHP) +1.09 (2.57 vs. +0.18 (1.94) p=0.046

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Ricauda 2008 Italy COPD	**Single blind RCT** **Intervention:** Geriatric home hospitalization service (GHHS, n=52) **Control:** General medical ward (GMW, n=52)	**Inclusion criteria:** Patients ≥75 yrs with a diagnosis of acute exacerbation of COPD, defined on Anthonisen criteria as an increase in breathlessness, sputum volume, or purulence for at least 24 hours, admitted to the ED & requiring hospitalization. Additional inclusion criteria were appropriate care supervision in the home, telephone connection, living in the HaH & informed consent. **Exclusion criteria** Absence of family and social support; severe hypoxemia (partial pressure of oxygen <50 mmHg); severe acidosis or alkalosis (pH <7.35 or >7.55); suspected pulmonary embolism; suspected myocardial infarction; severe comorbid illness as defined by presence of need for hemodialysis, severe renal impairment (glomerular filtration rate <20 mL/min), cancer (except skin cancer), hepatic failure, or severe dementia (Mini-Mental State Examination score <14). **Baseline characteristics of participants** Intervention vs. control Age, mean ±SD 80.1 ±3.2 79.2 ± 3.1p=0 .20 Male, n (%) 29 (56) 39 (75) p=0.06 Married, n (%) 27 (52) 29 (56) .84 Family support n (%) 52 (100) 52 (100) p=0.89 Current smoker, n (%)7(13)6(11) p=0.97Ex-smoker, n (%) 34 (65) 35 (67) p=0.95 FEV1, mean ±SD 0.92 ±0.4 1.04 ± 0.5 p=0.18 % of predicted FEV1 38, 47 Home oxygen use, n(%)18 (35)12 (23) p=0.45 Arterial blood gas, mean ±SD pH 7.40 ± 0.04 7.41 ± 0.03 .19 PP of O_2 69 ± 19 65 ±±14 .p= 0.23 PP of CO_2 44 ± 12 46 ± 12 .47 ADL score, mean ± SD± 2.3 ± 2.2 1.9 ± 2.2 p=0.36 IADL score, mean ± SD 7.1 ± 4.9 8.1 ± 4.2 .27 GDS score, mean ± SD 16.1 ± 6.1 17.2 ± 6.8 .45 Comorbidity index 2.6 ± 1.5 3.0 ± 1.8 p=0.24	**Outline of intervention** **Intervention delivered by;** **"**a physician-led substitutive hospital-at-home model of care" Patients assigned to HaH were immediately transferred home by ambulance. At home, a multi-dimensional geriatric assessment was conducted & patients received hospital-level treatment& services, as their condition dictated. (Physician and nursing visits, standard blood tests, pulse oximetry, electrocardiogram, spirometry,echocardiogram, echographs and Doppler ultrasonographs,oral & intravenous medication administration, including antimicrobials & cytotoxic drugs, oxygen therapy, blood products transfusion, central venous access, surgical treatment of pressure sores, physical therapy & occupational therapy The HaH program emphasized patient & caregiver education about the knowledge of the disease, giving advice about smoking cessation, nutrition,management of activities of daily living & energy conservation, understanding & use of drugs, health maintenance, & early recognition of triggers of exacerbation that required medical intervention.	**Outline of control** **Intervention delivered by:** The inpatient control group received routine hospital care	**Relevant measures & outcomes** ***Primary outcomes*** Hospital readmission & mortality rates at 6 months. ***Secondary outcomes*** Depression status -Geriatric Depression Scale, functional status- Katz activities of daily living & Lawton instrumental activities of daily living Cognitive status -Mini-Mental State Examination, Quality of life -the Nottingham Health Profile Nutritional status -Mini Nutritional Assessment, Caregiver characteristics - Relatives' Stress Scale, & satisfaction using ad hoc questionnaire for Scale. Costs of care were compared for the acute episode.	***Primary outcomes*** GHHS vs. GMW Hospital readmissions at6mths 42% vs 87%, P= 0.001 Cumulative mortality at 6 mths was 20.2% in the total sample, No significant differences between grps. ***Secondary outcomes*** Mean length of stay 15.5 ±9.5 vs 11.0 ± 7.9 days, P= 0.010 Only GHHS patients experienced improvements in depression and QoL scores but ns between grps There were no differences in functional, cognitive, nutritional, or caregiver burden outcomes. Satisfaction at discharge was very good or excellent for 94% vs. 88% (P=0.83) (On a cost per patient per day basis, ($101.4 ± 61.3 vs $151.7 ± 96.4, P=0.002).

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Rodriguez-Cerillo 2009 Spain non-massive Pulmonary embolism	**COS** **Intervention:** Home hospitalization (HH) (n=30) **Control:** Conventional Hospitalization (CH) (n=31)	**Inclusion criteria:** *For trial* Non-massive pulmonary embolism • No contraindications for treatment with low MW heparin • Absence of moderate to severe renal failure • Haemodynamic stability • O2 saturation higher than 92% breathing room air • No signs of heart failure • No arrhythmia • No haemoptysis *For HH* • Agreement to admission to our HH unit • A valid caregiver at home • Residence in our health area • A condition amenable to home management **Exclusion criteria** massive PE, haemodynamic instability, oxygen saturation lower than 92% on room air, heart failure, haemoptysis, arrhythmia & contraindication for treatment with low MW heparin **Baseline characteristics of participants** Age 66.8 (27–91) 66.7 (31–90) n.s Sex (males) 30% 54.8% n.s Diagnosed neoplasm 13.3% 9.7% n.s Associated DVT 40% 29% n.s Prior TED 0% 19.3% 0.05 Dementia 23.3% 6.4% n.s. Hypertension 30% 45.1% n.s. Ischaemic heart disease 6.6% 9.6% n.s. Thrombophilia 3.3% 0% n.s Recent surgery 3.3% 6.4% n.s Unilateral involvement 70% 61.3% n.s Bilateral involvement 30% 38.7% n.s Diagnosed by helical CT 26.6% 38.7% n.s	**Outline of intervention** **No detail**	**Outline of control** **No detail**	**Relevant measures & outcomes** No distinction between Primary and secondary outcomes Major and minor bleeding Re-thrombosis, Clinical course Unexpected returns to hospital Need for hospital re-admission in the following 3 months.	All comparisons ns Mean stay length HH vs. CH 8.9 days (7–14 days), vs. 10.6 days (6–20 days). All patients in study had a favourable clinical course. No major bleeding, re-thrombosis, or death occurred. One patient on HH experienced an abdominal wall haematoma in the area of administration of the low MW heparin. One patient admitted to hospital experienced a haematoma in the right arm related to blood sampling for laboratory tests. No patient with HH had infectious complications. Three patients admitted to hospital were diagnosed of urinary tract infection. No HH patients required unexpected return to hospital during admission. During follow-up, two patients required hospital admission, one in each group. The cause was not related to the thromboembolic disease.

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Carratala 2005 Spain Pneumonia	**Open RCT** **Intervention:** Outpatient care with oral levofloxacin therapy or hospitalization with sequential intravenous and oral levofloxacin therapy. (n=110) **Control:** Hospitalisation (n=114)	**Inclusion criteria:** All immunocompetent patients who were at least 18 years of age and had received a diagnosis of community acquired pneumonia in the emergency department (24 hrs per day, 7 days per week) Community acquired pneumonia was defined as the presence of a new infiltrate on chest radiography plus at least 1 of the following: fever (temperature ≥38.0 °C) or hypothermia (temperature <35.0 °C), new cough with or without sputum production, pleuritic chest pain, dyspnea, or altered breath sounds on auscultation. **Exclusion criteria** Neutropenia, HIV infection, transplantation, or splenectomy or who were taking immunosuppressive drugs **Baseline characteristics of participants** Male 69 (62.7) 66 (57.9) Female 41 (37.3) 48 (42.1) Mean age ± SD, *y* 67.5 ± 11.8 64.9 ± 13.4 Alcohol consumption ±80 g/d, *n (%)* 13 (12.4) 7 (6.4) Current tobacco smoking, *n (%)*‡ 21 (19.8) 24 (21.8) Influenza vaccine in current season, *n (%)*§ 44 (42.7) 49 (46.2) Pneumococcal vaccine in the previous 5 yrs, *n (%)*± 15 (15.6) 13 (13.1) Comorbid conditions, *n (%)* 71 (64.5) 78 (68.4) Mean oxygen saturation ± SD, *%* 94.5 ± 2.0 94.5 ± 1.8 Multilobar pneumonia, *n (%)* 8 (7.3) 9 (7.9) Risk class, *n (%)* II 55 (50.0) 63 (55.3) III 55 (50.0) 51 (44.7) Mean PSI score ± SD 70.0 ± 11.6 66.9 ± 12.5	**Outline of intervention** Outpatients were given oral levofloxacin (500 mg/d), and received detailed written information about their pneumonia diagnosis and their treatment plan, as well as emergency contact telephone numbers for a nurse or investigator physician. Patients were visited at home by a nurse 48 hours after emergency department discharge. The visit included assessment of vital signs and measurement of oxygen saturation by pulse oximetry. If the nurse thought that a patient's condition was not improving (worsening of baseline vital signs, oxygen saturation, or both), one of the investigators made an additional visit. The nurse was involved only in outcome assessment. Patients were seen at the outpatient clinic at days 7 and 30 after pneumonia diagnosis.	**Outline of control** Hospitalized patients received sequential intravenous and oral levofloxacin (500 m and received detailed written information about their pneumonia diagnosis and their treatment plan, as well as emergency contact telephone numbers for a nurse or investigator physician g/d) Patients assigned to hospitalization were seen daily during their hospital stay by attending physicians and by at least 1 of the investigators. Criteria for early switching from intravenous to oral levofloxacin were a respiratory rate of 24 breaths/min or less, a pulse rate of 100 beats/min or less, a temp of 37.8 °C or lower on 2 occasions at least 8 hours apart, and maintenance of adequate oral intake. Physicians were advised to discharge patients after their clinical condition stabilized, in accordance with previously recommended criteria. Patients were seen at the outpatient clinic at days 7 and 30 after pneumonia diagnosis.	**Relevant measures & outcomes** ***Primary outcomes*** % of patients with an overall successful outcome at the end of treatment, according to 7 predefined criteria: cure of pneumonia (as defined later), absence of adverse drug reactions, absence of medical complications during treatment, no need for additional visits, no changes in initial treatment with levofloxacin, **absence of subsequent hospital admission in the 30 days after randomization**, and absence of death from any cause in the 30 days after randomization. ***Secondary outcomes*** Patients' quality of life & satisfaction	Intervention vs. control ***Primary outcome*** Successful outcome was achieved in 83.6 vs. 80.7% (absolute difference, 2.9 % points [95% CI, ±7.1 to 12.9 % points]). % patients with adverse drug reactions (9.1% vs. 9.6%), Subsequent hospital admissions (6.3% vs. 7.0%), Overall mortality (0.9% vs. 0%) Medical complications (0.9% vs. 2.6%), ***Secondary outcomes*** All ns Quality of life (9.1% vs. 9.6%) Satisfied with overall care (91.2% vs. 79.1%; absolute difference, 12.1% [CI, 1.8 to 22.5 % points]).

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Kalra 2005 UK Stroke	**RCT** **Intervention:** **1)ST (n=152)** The stroke team involved management on general wards with specialist team support. The team undertook stroke assessments and advised ward-based nursing and therapy staff on acute care, secondary prevention and rehabilitation aspects. **2) DC (n=153)** **Domiciliary care provided management at home under the supervision of a GP and stroke specialist with support from specialist team and community services. Support was provided for a maximum of 3 months**. **Control:** Usual care **SU (n=152)** The stroke unit provided 24-hour care provided by a specialist multidisciplinary team based on clear guidelines for acute care, prevention of complications, rehabilitation and secondary prevention.	Patients were included within 72 hours of stroke onset. The research team was notified by telephone or fax by GPs for patients at home, and by accident and emergency (A&E) services for suspected stroke patients presenting to the casualty department. **Inclusion criteria:** Patients with disabling stroke who could be supported at home with nursing, therapy and social services input on initial assessment were included in the study. **Exclusion criteria** Patients with mild stroke, severe strokes, already admitted to hospitals, and those with unusual or atypical neurological features who required specialised assessments or investigation to establish a diagnosis of stroke. Patients who were institutionalised or had severe disability (Rankin 4 or 5) before stroke **Baseline characteristics of participants SU vs. ST vs.HC** Median age (years) (IQR) 75 (72–84) 77.3 (71–83) 77.7 (67–83) No. of females (%) 69 (46.6) 76 (50.6) 68 (45.6) Living alone (%) 50 (33.7) 55 (36.6) 50 (33.5)	**Outline of intervention** **ST** Patients were managed on general wards & under care of admitting physicians. All patients were seen by specialist team: doctor (specialist registrar grade), a nurse (grade G), a physiotherapist (senior I) and an occupational therapist (senior I) with expertise in stroke management. Patients were assessed by the specialist team, which undertook a diagnostic evaluation and assessment for needs. Ward provided the day-to-day treatment, the team advised on specialist aspects of stroke care. It reviewed progress and treatment of individual patients with ward team & helped in discharge planning and setting up of post discharge services. The team provided counselling, education and support to the family, identified expectations and advised about realistic outcomes in the context of previous morbidity and present deficits. **DC** Patients were managed in own home by a specialist team consisting of a doctor (specialist registrar), a nurse (G grade) & therapists (senior I grades), with support from district nursing and social services for nursing and personal care needs. Patients were under the joint care of the stroke physician and GP. Investigations, including CT scanning, were performed in outpatient s. Therapy was provided by members of the specialist stroke team. Each patient had an individualised integrated care pathway outlining activities and the objectives of treatment, which was reviewed at weekly multi-disciplinary meetings.	**Outline of control** **SU** Care was provided by a stroke physician supported by a multidisciplinary team with specialist experience in stroke management. There were clear guidelines for acute care, prevention of complications, rehabilitation and secondary prevention, and a culture of joint assessments, goal setting, coordinated treatment and discharge planning. A coordinated multidisciplinary approach was adopted towards rehabilitation, with emphasis on early mobilisation. All patients had an individualised rehabilitation plan with clearly defined goals based on joint assessments. Patient participation was encouraged, with focus on motivation and providing an enriched environment.	**Relevant measures & outcomes** ***Primary outcomes*** Death or institutionalisation at 1 year. Dependence - modified Rankin Scale (mRS), ***Secondary outcomes included*** Orgogozo scale, BI and FAI for disability, the mRS for handicap EuroQol-quality of life of patients and their carers.	Mortality and institutionalisation at 1yr were lower on SU vs.ST or DC Significantly fewer patients on SU died compared with ST The proportion of patients alive without severe disability at 1 year was also significantly higher on SU vs. ST or DC. These differences were present at 3 & 6 mths after stroke. Stroke survivors on SU showed greater improvement on basic activities of daily living compared the other two grps. Achievement of higher levels of function was not influenced by strategy of care. QoL at 3mths was significantly better in SU & DC patients. There was greater dissatisfaction with care with ST vs. SU or DC. Poor outcomewith DC and ST was associated with Barthel Index <5, incontinence and with ST, age >75 years. The total costs of stroke per patient over 12mths were £11,450 for SU, £9527 for ST & £6840 for DC The mean costs per day alive for the SU were significantly less than those for the ST , but no different from DC patients. Costs for DC were significantly less than for those managed by the SU or ST.

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Rodriguez-Cerrillo 2013 Spain uncomplicated diverticulitis	**Prospective controlled study** **Intervention:** Patients stayed 24 h in the Observation Ward within ED prior to discharge and treatment at home. (n=34) **Control:** Traditional hospitalization (n=18)	**Inclusion criteria:** ≥70 years diagnosed with uncomplicated diverticulitis (The existence of abscess, fistula, bowel obstruction and peritonitis) Patients who were willing to be treated at home and had a caregiver 24 h a day were transferred to HaH. The rest of the patients were admitted to conventional hospitalization. **Exclusion criteria** Patients with complicated diverticulitis, β-lactam allergy or who required admission to hospital for other pathology **Baseline characteristics of participants** intervention vs. control Age 77 (71–90) 79 (71–98) Sex (female) 28 (82.4%) 16 (84.2%) Cardiopathy 9 (26.5%) 6 (31.6%) Diabetes mellitus 4 (11.7%) 2 (10.5%) Chronic renal failure 4 (11.7%) 1 (5.2%) Neoplasm 1 (2.9%) 1 (5.2%) COPD 1 (2.9%) 1 (5.2%) Corticosteroids 4 (11.7%) 2 (10.5%) Previous diverticulitis 7 (20.5%) 3 (15.8%) Abdominal pain 34 (100%) 19 (100%) Fever 9 (26.5%) 6 (31.6%) Diarrhea 6 (17.6%) 3 (15.8%) Leucocytosis 7 (20.5%) 3 (15.8%)	**Outline of intervention** **Intervention delivered by;** All patients were given Ertapenem after diagnosis. Patients in HaH grp stayed 24 h in the observation ward within ED prior to discharge. At home, nurses administrated Ertapenem every day. The physician conducted 2–3 home visits per week, depending on the patient's clinical course. On admission patients were provided with a phone number to contact the unit if any problem arose. Intravenous antibiotic was changed to oral therapy (amoxicillin–clavulanate) after 4–6 days of treatment until complete 10 days of treatment.	**Outline of control** **Intervention delivered by:** All patients were given ertapenem after diagnosis & experienced traditional hospitalisation	**Relevant measures & outcomes** No primary nor secondary outcomes were defined	A small amount of free fluid was present in 38% of patients treated with HaH and 42% of patients in hospital. All patients had a good clinical evolution. None of the patients treated with HaH needed be transferred to hospital. Mean stay was 9 days in HaH vs. 10 days in Hospital. The cost of each patient with diverticulitis treated at home was 1368 euros cheaper than the cost of a patient treated in the hospital (fewer staff and important reduction of maintenance costs).

Author Year Country	Study	Participants	Intervention		Control	Outcomes assessed	Results
Leff **[3066]** **2005** **USA** **Plus** Leff 2009 [2545] Frick 2009 [0158]	**Prospective quasi experimental** 2 consecutive 11 month phases **Intervention:** Treatment in a hospital-at-home model of care that substitutes for treatment in an acute care hospital. Offered In the 2nd phase of study n=169 **Control:** Described as 'observation group' in the first phase of study. Eligible patients were identified and followed through usual hospital care. n=286 **Aim:** 'to evaluate the safety, efficacy, clinical and functional outcomes, patient and caregiver satisfaction, and costs of providing acute hospital level care in a hospital at home that substituted entirely for admission to an acute care hospital for older persons.' **Setting:** **Intervention** (if received): At home **Control** **Secondary hospital care** ***Power calculation***: No	**Inclusion criteria:** Community-dwelling persons ≥65 yrs old, Lived in catchment area In the opinion of a physician not involved in study, required admission to an acute care hospital for these illnesses: community-acquired pneumonia, exacerbation of chronic heart failure or chronic obstructive pulmonary disease, or cellulitis. Required to meet validated criteria of medical eligibility for hospital-at-home care. **Exclusion criteria** Most common reasons for medical ineligibility were uncorrectable hypoxemia, suspected myocardial ischemia, and presence of an acute illness, other than the target illness, for which the patient was required to be hospitalized. **Baseline characteristics of participants at all sites (Stats shown if signif)** Observation vs. intervention Age (SD) 77.3 (6.6) vs.77.2(7.0) % female 34 vs. 42% % white 90 vs.86% **% in poverty 11 vs.19% p=0.027** **% live alone 43 vs.33% p=0.022** Mean mini mental state (SD)25.5 (4.2) vs. 25.2(4.4) Mean Charlson score (SD) 3.1 (2.0) vs.3.0 (1.8) **Mean medications (SD) 6.8 (3.9) vs. 8.1(4.5) p=0.002** %Primary admission diagnosis Pneumonia 31vs. 32% COPD 32 vs.28% Cellulitis 12 vs 18% CHF 25vs.22%	The study was conducted in 3 Medicare managed care (Medicare +Choice) plans at 2 sites and at a Veterans Administration medical centre. Univera Health and Independent Health, in Buffalo, New York, are Medicare + Choice plans These 2 plans collaborated to provide hospital- at-home care and made up 1 study site (site 1). The Fallon Health Care System (site 2), in Worcester, Massachusetts, operates a not-for-profit Medicare +Choice plan, and the Fallon Clinic, a for-profit multispecialty physician group, provides care on a capitated basis to Medicare + Choice beneficiaries. The Portland, Oregon, Veterans Administration Medical Center (site 3) is a quaternary care and teaching facility. A patient requiring admission to the acute care hospital for a target illness was identified in an ED or ambulatory site and his or her eligibility status was determined. Non-study medical personnel, usually ED physicians, made the decision to hospitalize the patient. All patients who were offered but who declined hospital-at-home care were admitted to the acute care hospital. Study coordinators verified the patient's eligibility for HaH using a standard protocol at enrolment. Most patients were identified the morning after admission.	**Outline of intervention &who delivered** 1 Nov 2001-30 Sep 2002 Patients evaluated by HaH physician either in ED or after ambulance transfer to home. HaH nurse met ambulance at patient's home and provided direct one-on-one nursing for an initial period of ≤ 8hrs at site 3 and ≤24 hrs at sites 1 & 2. followed by intermittent nursing visits and HaH physician at least daily. HaH physician was available 24 hours a day for visits. Nursing and other care components, e.g. durable medical equipment, oxygen therapy were provided and some services e.g. home radiology, support provided by independent contractors. Lifeline devices were provided for patients living alone. Diagnostic tests , IV fluids, IV antimicrobial agents, etc. and oxygen/respiratory therapies were provided at home. Patient was followed by same physician until discharged to primary care	**Outline of control** 1 Nov 1990- 30 Sep 2001) Eligible patients identified & followed through usual hospital care.	**Relevant measures & outcomes** **No distinction between primary and secondary outcomes** Intervention group comprised all patients eligible for hospital-at-home care, irrespective of where they were treated. [thus some outcomes are NOT useful to us but some measures are HaH specific] **Mean LoS (SD) days [Leff 2005]** ***Mean time in ED (SD) in hrs*** ..... Sub-analysis of HaH vs. Non-HaH (i.e. different to main report [Leff 2009] ***Changes in ADL and IADL from 1mth before admission -2 weeks after intervention*** **Costs** ***Within each health system and per condition*** [Frick 2009] **Overall summary** 'The HaH care model is feasible, safe, and efficacious for certain older patients with selected acute medical illnesses who require acute hospital-level care.' Leff 2005 HaH care is associated with modestly better improvements in IADL status and trends toward more improvement in ADL status than traditional acute hospital care. Leff 2009 Total costs seem to be lower when substitutive HaH care is available for patients with CHF or COPD disease.Frick2009	Intervention vs. control **Mean LoS (SD) days** **4.9 (9.9) 3.2 (2.5) p =0.004** ***Mean time in ED (SD) in hrs*** **6.4(1.8,11.6)SD 1.9 vs. 5.5(1.0,21.3) SD3.2** **P=0.001** [Leff 2005] ---------- ***Changes in ADL and IADL from 1mth before admission -2 weeks after intervention*** ADL 0.39(3.13) vs. -0.6(3.09) p=0.1 **IADL 0.74(2.86) vs. -0.70(2.68) p=0.007** [Leff 2009] --- **Costs** ***Within each health system and per condition*** **Mean (SD)** Overall **$5081(4427)vs.$7480(8113) p<0.001** Pneumonia $5272(6036) vs. $6761(6451) NS Congestive heart failure **$3310(2118) vs. $6399(6643) p≤0.001** COPD **$4293(3806) vs. $6500(7305) p≤0.05** Cellulitis $4262(2309) vs. $7287(11471) NS [Frick 2009]

Hospital in Nursing/Care Home (HNCH) (n=2)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Crilly 2010 Australia	**'quasi experimental'** **[Controlled (his) study]** **Intervention:** Hospital in the nursing home (HINH) n=62 **Control:** Usual in-hospital care n=115	**Inclusion criteria:** Reside in an ACF. Have a signed GP request for HINH review from the ACF. Be of any age (usually≥ 65 yrs). Present with an illness that required hospital services but not necessarily admission e.g. UTI & could have treatment e.g. antibiotics continued by ACF staff. Prior to start of HINH, patients who would have fit inclusion criteria for hospital admission **Exclusion criteria:** ACF residents who required extensive treatment that could not be managed in ACF or who required specific services that could only be received in hospital e.g. surgery **Baseline characteristics of participants** **HINH vs. Control** Age (SD) 85(7.1) vs.84.6(6.6)years Triage category 3.2 (0.7) vs.3.2(0.7) Female 76vs. 75% Diagnostic category: Respiratory 24 vs.26% Cellulitis 18 vs.17% Kidney/urinary tract 18vs.16% Cardiac 10 vs. 10 % Abdominal/GI 8vs.8% Viral/sepsis 7 vs.6% All other 16 vs.17%	In the ED. Enrolments were made by HINH programme manager (registered nurse) with programme director (ED director), GPs and ACF nursing staff, as appropriate. After hours and on weekends, if patient was suitable for HINH , they stayed in ED short stay unit and were reviewed by HINH nurse on next weekday. **Outline of intervention** The HINH nurse checks with the ACF registered nurse and patient on the patients' progress initially on a daily basis and then every couple of days. Discharge occurs when required treatment has ceased. This completes the patients' hospital-affiliated episode. **Intervention delivered by:** HINH programme delivers acute care nursing support services, medication and equipment to the ACF registered nurse and/or enrolled nurse. These services may include initial training and education regarding antibiotic or IV fluid administration; specific wound treatment and dressing procedure (with dressing materials); suprapubic catheter care, behaviour management and palliative care.	**Outline of control** The comparison group was selected from patients who presented to ED and were subsequently admitted during the same time period. To be included in this group, the patients had to reside in an ACF and be aged ≥65yrs. ACF residents who presented to the ED were in some cases not enrolled in HINH because they had a medical problem that was judged as possibly requiring in-hospital admission services beyond those offered by the HINH. **Intervention delivered by:** No details but presumably usual hospital staff	**Relevant measures & outcomes** ***Hospital LOS (days)*** ***ED LOS (hours)*** ***Episode of care (total time) LOS (days)*** ***Long (≥6days) vs. short hospital LOS*** ***Long (≥8 days) ED LOS vs. short*** ***Long episode of care (≥6 days)*** ***Hospital readmissions within 28 days*** ***Costs*** None	HINH vs. Control Mean (SD) ***Hospital LOS*** **2.19 (0.82) vs.6.2(0.59) days p<0.001** ***ED LOS*** **9.94(0.66) vs. 7.01(0.47) hrs p=0.005** ***Episode of Care LOS*** 9.56(1.26)vs. 6.20(0.59) days p=0.14 Percentages ***Hospital LOS 6+days*** **9.6 vs. 40 p<0.001** Episode of care 6+days 46.8 vs.40.0 p=0.35 ***LOS in ED 8+ hours*** **50.0vs.33.9 p=0.05** ***Readmission in 28 days*** 11.3 vs. 11.3 p=0.99

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Lau **2013** **Australia**	**Controlled (his) Case series** **Intervention** Treatment in residential care facilities (TRC) grp **n=95** **Control** Hospital-based aged care unit (ACU) **n=167**	**Inclusion criteria:** Patient and/or family consent Capacity within HITH to accept the patient Facility able to manage the care needs of the patient in the residential aged care facility (RACF) **Exclusion criteria:** Lack of consent from patient and/or family. Behavioural disturbances, which may prevent the delivery of care e.g. aggressive behaviour and frequent removal of IV, access device. History of recent falls, which may impact on the delivery of care in the RACF. If there was conflict regarding management, further input and discussion were carried out in ACU. **Baseline characteristics of participants** TRC vs. ACU **Age** 83.5 vs.82.8yrs **Female** 53 vs.59% **Non-English speaking** 42 vs.48% **High level of nursing homecare** 72 vs.76% **Dementia 77.9vs.45.5% p<0.001** **Charlson score** 7.1 SD 1.9 vs. 7.2 SD 2.3	In the ED the acuity of presenting complaint was triaged to maximize service capacity. Overnight referrals were assessed next morning, (those who presented after hours were put in Short Stay Unit adjacent to ED for assessment. TRC generally provided once daily visits for patient. The geriatrician & team members would use clinical judgement to determine if a patient was suitable for TRC **Outline of intervention** Treatment in Residential Care facilities (TRC) delivered by the Residential Care Intervention Program into the Elderly (RECIPE) service between July-Oct 2008. **Appropriate Clinical Diagnosis** Dehydration, Pneumonia, Urinary Tract Infection, Gastroenteritis, Deep Venous Thrombosis, Terminal care support. **Treatment can therefore include any of the following:** IV antibiotics & IV fluids Anticoagulation Oxygen therapy (low flow) Appropriate Allied Health intervention Palliative support* Referral to other appropriate support programs * [TRC also offered palliative care as appropriate. If patient's condition changed and management could not be continued, transfer into acute hospital was organized. If patients had uncertain prognosis, treatment was given, followed by palliative care if no response despite optimal treatment.] **Intervention delivered by:** Geriatrician, registrar and nursing staff with access to allied health staff such as physiotherapy, OT, speech pathology and social work.	**Outline of control** Aged care unit (ACU) Inpatients treated in ACU in preceding year July-October 2007, before existence of TRC. ACU is a service for inpatients who have been admitted from residential care facilities for the management of general medical conditions. **Intervention delivered by:** No details but presumably usual hospital staff	**Relevant measures & outcomes** ***Palliative care*** ***Mortality on discharge*** ***6-month mortality*** ***Rehospitalisation within 1-month*** ***Total hospitalisation at 6 months*** **Length of hospital care/stay** All measured as 'present or not' **Costs** None	TRC vs. ACU ***Palliative care*** **34 (35.8%) 13 (7.8%) <0.001** ***Mortality on discharge*** 11 (11.6%) 20 (12.0%) p=0.924 ***6-month mortality*** 29 (30.5%) 51 (30.5%) p=0.184 ***Re-hospitalization within 1 month*** 20 (21.1%) 35 (21.0%) p=0.986 ***Total re-hospitalization at 6 months*** 39 (41.1%) 68 (40.7%) p=0.963 ***Length of stay*** **Mean (no SD given) 2vs.11 days** **P<0.001** Equivalent of 270 vs. 1840 bed days

Appendix 6: Characteristics of those older patients for whom the decision to admit to hospital may be unclear

Patient characteristics	Studies which include such populations
Age ≥75 years for included patients	15/19 studies Mason 2007 & 2012; Benaiges 2014; Salvi 2008; Garasen 2007; Vincente 2014; Patel 2008; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Kalra 2005; Rodriguez-Cerillo 2013; Leff 2005; Crilly 2010; Lau 2013
Co/multi-morbidities in included patients stated either by number of conditions or multi-morbidity score e.g. Charlson Score	9/19 studies Benaiges 2014; Salvi 2008; Patel 2008; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Carratala 2005; Leff 2005; Lau 2013
Dementia either stated in a) patient demographics or b) used as an exclusion criterion based on severity	a) 2/19 studies Rodriguez-Cerillo 2009; Lau 2013 b) 8/19 studies Mason 2007; Sun 2014; Salvi 2008; Garasen 2007; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Lau 2013
Social care support stated in inclusion/exclusion criteria	3/19 studies Tibaldi 2009; Ricauda 2008; Kalra 2005;
Home situation stated in inclusion/exclusion criteria	7/19 studies Benaiges 2014; Garasen 2007; Mendoza 2009; Ricauda 2008; Rodriguez-Cerillo 2009, 2013; Lau 2013
Individual coping abilities stated in inclusion/exclusion criteria	2/19 studies Patel 2008; Rodriguez-Cerillo 2013

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NHS
National Institute for
Health Research

PROSPERO International prospective register of systematic reviews

A systematic review to identify and assess the effectiveness of hospital alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission

Alyson Huntley, Melanie Chalder, Will Hollingworth, Chris Metcalfe, Ben Davies, Sarah Purdy

Citation

Alyson Huntley, Melanie Chalder, Will Hollingworth, Chris Metcalfe, Ben Davies, Sarah Purdy. A systematic review to identify and assess the effectiveness of hospital alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission. PROSPERO 2015:CRD42015020371 Available from http://www.crd.york.ac.uk/PROSPERO_REBRANDING/display_record.asp?ID=CRD42015020371

Review question(s)

1) What admission alternatives are there for older patients and do they improve patient outcomes e.g. mortality, quality of life?

2) What are the defining characteristics of those older patients for whom the decision to admit to hospital may be unclear?

Searches

MEDLINE, MEDLINE in process, EMBASE, CINAHL and the Cochrane Central Register of Controlled Trials (CENTRAL) from 2005 to April 24th 2015. The Kings Fund and AHRQ websites were also searched

Types of study to be included

Any type of controlled study

Condition or domain being studied

Any condition that may result in an avoidable hospital admission in patients over the age of 65.

Participants/ population

People over 65 years of age of either sex living in OECD countries who are at risk of an unplanned admission (probably for an ambulatory sensitive condition) - they will therefore not be admitted to hospital at time of recruitment but could be in community or emergency department (being assessed).

Intervention(s), exposure(s)

The intervention of interest is admission to hospital, using definitions developed for previous studies (Huntley et al, Family Practice Fam Pract. 2013 Jun;30(3):266-75.). However it is important to point out that admission is likely to be the control group in many relevant studies.

Comparator(s)/ control

Alternatives to admission (likely to be described as the intervention) including but not limited to: hospital at home, virtual ward, rapid response nursing, care at home, admission to a care home, usual care.

Context

Reducing emergency bed days is one of the biggest challenges currently facing the National Health Service (NHS). There is considerable pressure to reduce hospital admissions amongst older people (D'Souza, BMJ 2013). There has been a 65% increase in hospital admissions for those over 75 years of age in the last decade ,and the oldest old, those over 85 years , now account for 11% of emergency admissions and 25% of bed days (NHS England 2013). There are some older people for whom care in the community is safe,perhaps with the provision of additional services and some for whom admission is required in order to deliver diagnostic or treatment techniques that are only available as an in patient. This review seeks to identify interventions for those patients that do not fall neatly into one of these categories and in doing so will assess the efficacy of the interventions and provide more detail on this patient

population.

Outcome(s)

Primary outcomes

1) Patient outcomes (including mortality, quality of life, length of stay, readmission, adverse effects of intervention) plus costs if available.

2) Patient characteristics for whom their pathway (admission or not) is unclear including risk factors e.g. co-morbidities (mental & physical), age, gender, social circumstances ,disease severity, recent admission/discharge availability of other services

Secondary outcomes

None

Data extraction, (selection and coding)

Standardised data extraction forms will be developed using existing guidelines (Higgins 2008 Cochrane handbook chapter 7 section 7.5). Data will be abstracted by one reviewer. A second reviewer will check data abstraction against the original paper. Data items: details on participants, Interventions, comparisons,outcome measures

Risk of bias (quality) assessment

Cochrane risk of bias tool will be used for randomised controlled trials. CASP criteria will be used for controlled trials

Strategy for data synthesis

Meta-analysis of data will be performed using Review Manager Version 5.1 if there are at least three trials with combinable data with a fixed or random effects model depending on the level of between trial heterogeneity estimated using the I-squared statistic. Sensitivity analysis will be performed as the data dictates.

Analysis of subgroups or subsets

Dependent on data found

Dissemination plans

This review is part of programme development grant.

Contact details for further information

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Details of any existing review of the same topic by the same authors
None

Anticipated or actual start date
02 February 2015

Anticipated completion date
29 January 2016

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NIHR Programme Development Grant RP-DG-1213-10004

Conflicts of interest
None known

Language
English

Country
England

Subject index terms status
Subject indexing assigned by CRD

Subject index terms
Hospitalization; Hospitals; Humans

Stage of review
Ongoing

Date of registration in PROSPERO
14 May 2015

Date of publication of this revision
14 May 2015

DOI
10.15124/CRD42015020371

Stage of review at time of this submission	Started	Completed
Preliminary searches	No	Yes
Piloting of the study selection process	No	Yes
Formal screening of search results against eligibility criteria	Yes	No

Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Pages 2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Page 5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Pages 5-6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Page 6
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Page 6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Pages 6-7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Page 7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Page 7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Page 8

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Page 7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Page 8 and Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Pages 8-17
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Pages 8-17 and Appendices 2 & 3
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Pages 8-17 and Appendix 5
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Pages 8-17 plus narrative presentation
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Pages 8-17
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Page 18
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Pages 18-19
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Page 19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Page 21

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

PRISMA 2009 Checklist

BMJ Open

A systematic review to identify and assess the effectiveness of alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission.

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Manuscript ID	bmjopen-2017-016236.R2
Article Type:	Research
Date Submitted by the Author:	31-May-2017
Complete List of Authors:	Huntley, Alyson; University of Bristol , School of Social & Community Medicine Chalder, Melanie; University of Bristol, School of Social & Community Medicine Shaw, Ali; University of Bristol, School of Social & Community Medicine Hollingworth, William; University of Bristol, School of Social & Community Medicine Metcalfe, Chris; University of Bristol, Bristol Randomised Trials Collaboration; University of Bristol , School of Social & Community medicine Benger, Jonathan; The University Hospitals NHS Foundation trust, Academic Department of Emergency care; The University of the West of England, Faculty of Health & Life Sciences Purdy, Sarah; University of Bristol, School of Social & Community Medicine
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Geriatric medicine
Keywords:	GERIATRIC MEDICINE, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, ACCIDENT & EMERGENCY MEDICINE

31.05.17

A systematic review to identify and assess the effectiveness of alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission.

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Word count 4335

Key words: Systematic review, emergency medical services, aged, hospitalization, hospital alternative

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ABSTRACT

Background / objectives

There are some older patients who are 'at the decision margin' of admission. This systematic review sought to explore this issue with the following objective: What admission alternatives are there for older patients and are they safe, effective and cost-effective? A secondary objective was to identify the characteristics of those older patients for whom the decision to admit to hospital may be unclear.

Design

Systematic review of controlled studies (April 2005-December 2016) with searches in Medline, Embase, Cinahl and CENTRAL databases. The protocol is registered at PROSPERO (CRD42015020371). Studies were assessed using Cochrane risk of bias criteria, and relevant reviews were assessed with the AMSTAR tool. The results are presented narratively and discussed.

Setting

Primary and secondary health care interface.

Participants

People aged over 65 years at risk of an unplanned admission.

Interventions

Any community-based intervention offered as an alternative to admission to an acute hospital

Primary and secondary outcomes measures

Reduction in secondary care use, patient-related outcomes, safety and costs.

Results

Nineteen studies and seven systematic reviews were identified. These recruited patients with both specific conditions and mixed chronic and acute conditions. The

interventions involved paramedic/emergency care practitioners (n=3), emergency department-based interventions (n=3), community hospitals (n=2), and hospital-at-home services (n=11). Data suggest that alternatives to admission appear safe with potential to reduce secondary care use and length of time receiving care. There is a lack of patient-related outcomes and cost data. The important features of older patients for whom the decision to admit is uncertain are: age over 75 years, co/multi-morbidities, dementia, home situation, social support and individual coping abilities.

Conclusions

This systematic review describes and assesses evidence on alternatives to acute care for older patients and shows that many of the options available are safe and appear to reduce resource use. However, cost analyses and patient preference data are lacking.

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STRENGTHS AND LIMITATIONS OF THIS REVIEW

1. High quality systematic review of controlled studies.

2. Some of the studies are pragmatic in approach and are at high risk of bias.

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Introduction

Reducing emergency bed days is one of the biggest challenges currently facing the National Health Service (NHS) in the United Kingdom (UK) and there is considerable pressure to reduce hospital admissions amongst older people throughout the developed world.[1] It has been suggested that clinicians should: 'choose to admit only those frail older people who have evidence of underlying life-threatening illness or need for surgery'.[2] In the UK there has been a 65% increase in hospital admissions for those over 75 years of age in the last decade. Furthermore, people over 85 years of age now account for 11% of emergency admissions and 25% of critical care bed days.[3] The international literature indicates that decisions to admit to an acute hospital are often influenced by inadequate knowledge of the patient or condition, communication difficulties between primary and secondary care, presence of co-morbidities, availability of test results, perceived benefits of in-patient care and patient preferences.[4] A review by NHS England highlighted the need to identify those frail and elderly people who need care but do not have a medical need requiring hospital admission.[3] It is clear that there are some older patients for whom care in the community is safe, perhaps with provision of additional services, and some for whom admission is required to deliver diagnostics or treatment that are only available in hospital. However, for those patients 'at the decision margin', the best path of action may be unclear.[5] The decision may be affected by non-clinical and clinical factors e.g. multi-morbidity, how much risk the patient or family are willing to accept.

Our specific objective was to conduct a systematic review to identify studies of community-based interventions aimed at reducing secondary care use in older patients with acute medical problems potentially requiring unscheduled hospital

admission. A secondary objective was to further confirm the characteristics of those older patients for whom the decision to admit to hospital may be unclear.

Methods

Protocol and registration

The protocol for the systematic review was registered at the PROSPERO register on 14/06/2015. Registration number is: CRD42015020371 (Supplementary material)

Eligibility criteria

Publications of any randomised or non-randomised controlled trial (RCT or nRCT) which fitted our PICO criteria: a **P**opulation aged over 65 years, of either sex living in Organisation for Economic Co-operation and Development countries being considered for an unplanned admission, receiving either an **I**ntervention considered to be an alternative to acute hospital admission or acute hospital admission (**C**ontrol). The studies needed to record at least one of the following as either a primary or secondary **O**utcome: intervention effectiveness in terms of patient's subsequent ED attendance or readmission, patient-related outcomes, safety or healthcare costs.

Information sources and searches

Medline, Medline In-Process, Embase, Cinahl and CENTRAL databases were searched from January 2005-April 2015 inclusive using search terms based on the eligibility criteria. (Appendix 1) An update was run in December 2016 across Medline and Medline In-Process. We included any relevant systematic reviews published 2010- 2016. The decision to time limit the searches was based on the fact that the systematic reviews would cover any older studies and that any evidence not included in these two sources was unlikely to be relevant to the fast changing

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primary and secondary health care interface. The King's Fund and Agency for Healthcare Research and Quality websites were also searched in April 2015.[6,7] References were managed using EndNote X6 software and were screened by title and abstract followed by full text, both independently and in duplicate (AH, BD), using predefined inclusion/exclusion criteria. Any disagreements in either stage were resolved using a third reviewer (SP). The reference lists of included studies were checked and forward referencing was conducted using Google Scholar. Authors of included studies were contacted for details of any extra studies.

Data items and collection process

Data from all primary studies (2005-2016) were extracted into a custom-designed table. The main results and conclusions of recent high quality systematic reviews (2010-2016) which included relevant primary studies were also recorded.

***Assessment of risk of bias of individual studies* (Appendix 2)**

The Effective Practice and Organisation of Care Cochrane risk of bias tool was used to critically appraise RCTs and nRCTs.[8]

***Assessment of methodological quality of systematic reviews* (AMSTAR) *(*Appendix 3)**

The AMSTAR checklist was used to assess the quality of the included systematic reviews.[9]

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Synthesis of results

The data are presented narratively describing, if present, the most relevant systematic review and/or individual studies for each intervention and, where appropriate, for a specific condition.

In order to identify the characteristics of those older patients for whom the decision to admit to hospital may be unclear, the inclusion/exclusion criteria and demographics of the participants were examined and key features were tabulated alongside the number and references of relevant studies.

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Summary Table: RCT/nRCT and systematic evidence for alternative to admissions for the older population

Intervention/ setting	**Paramedic/ emergency care practitioner**	**Emergency department**	**Community hospital**	**Hospital at home** Heart Failure	**Hospital at home** COPD	**Hospital at home** Pulmonary embolism	**Hospital at home** Pneumonia	**Hospital at home** Stroke	**Hospital at home** Uncomplicated diverticulitis	**Hospital at home** Older population with acute medical problems
Primary studies identified 19 studies over 24 papers n=10 RCT, n=9 nRCT	n=3 (RCT & 2 nRCT) Mason 2007 Gray 2008 Mason 2012	n=3 (RCT & 2 nRCT) Sun 2014 Benaiges 2014 Salvi 2008	n=2 RCT Vicente 2014 Garåsen 2007, 2008ab	n=3 RCT Mendoza 2009/García-Soleto 2013 Tibaldi 2009 Patel 2008	n=1 RCT Ricauda 2008	n=1 nRCT Rodriguez-Cerillo 2009	n=1 RCT Carratala 2005	n=1 RCT (3 arm) Kalra 2005	n=1 nRCT Rodriguez-Cerrillo 2013	n=3 nRCT Leff 2005/2009/Frick 2009 Crilly 2011 Lau 2013
Main conclusions of primary studies Statistically significant differences between alternative care and acute hospital care	Mason RCT **Reduction:** Risk of ED attendance, Risk of hospital readmission. **Increase:** Satisfaction with care Mean duration of care Subsequent unplanned contacts with secondary care **Comparable:** Mortality Two nRCTs report greater reduction in admissions No cost data	Sun RCT **Reduction:** Time of episode of care Less likely to be admitted into hospital Costs **Comparable:** Serious events QoL Satisfaction with care ********** Benaignes nRCT **Reduction:** Readmissions Costs ********** Salvi nRCT no differences	Vincente Data limited. Neither formal analyses nor cost data presented. ********** Garåsen **Reduction:** Hospital readmissions Receiving any care at 26 wks Deaths Total costs & mean costs per patient **Increase:** Observation period **********	Meta-analysis in systematic review	**Reduction:** Readmissions Mean cost per patient **Increase:** Length of stay. **Comparable:** Depression QoL Mortality	**Comparable:** Mean length of stay No major bleeding, thrombosis or death in either group No cost data	**Increase:** Patients were satisfied with care **Comparable:** An overall 'successful outcome' Readmissions QoL Adverse drug reactions Medical complications Mortality No cost data	**Increase:** Mortality & institutionalisation . **Reduction:** QoL scores basic activities of daily living Costs were lower for HaH group but eclipsed by poorer patient outcomes.	Limited data. **Reduction:** Cost reduction of €1368 per patient. **Comparable:** Mean length of stay	Leff **Reduction:** Length of stay Mean treatment cost **Comparable:** Use of health services ED visits or readmission ********** Crilly **Increase:** Longer time in ED **Comparable:** Length of episode of total care No mortality or cost data ********** Lau **Reduction:** Length of stay **Comparable:** Mortality Readmissions No cost data
Systematic review identified	NO	NO	NO	Quaddoura 2015	Jeppesen 2012	Vinson 2012	Chalmers 2011	Shepperd 2016 Chalmers 2011	Varney 2014	NO
Description of, and main conclusions of systematic review				3 RCTs as above used in meta-analysis **Increase:** Time to first readmission HQoL at 6 &12 mths **Reduction:** Costs for index treatment **Comparable:** Rate of readmission All-cause mortality	8 RCTs 7 did not fit inclusion criteria plus RCT detailed above. **Review summary:** Selected COPD patients can be safely & successfully treated at home. Favourable readmission rates. A trend towards reduced mortality rate	7 observation studies plus one nRCT detailed above. **Review summary:** Data are limited, but evidence supports the feasibility & safety of for carefully selected low risk patients.	5 studies comprising variety of designs plus one RCT detailed above **Review summary:** Interventions appear safe. Comparable for mortality, hospital readmissions patient satisfaction. Insufficient data for quality of life or return to usual activities.	Two previous systematic reviews on a mixture of conditions including one RCT described above	Integrative review on admission-avoidance HaH services and included one nRCT described above	

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Results

The systematic review identified four types of intervention from across 19 studies published in 24 papers: paramedic/emergency care practitioners (n=3), emergency department (ED) interventions (n=3), community hospitals (n=2), hospital-at-home services (n=11).[10-33] (PRISMA diagram) (Appendix 4) Ten of the included studies were RCTs and nine were nRCTs.(Summary table) Fifteen studies were conducted in western European countries of which four were in the UK. Two studies were conducted in Australia and two studies in the United States (US). Risk of bias, general intervention description, AMSTAR and study data are detailed in the appendices. (Appendix 1) (Appendix 2)(Appendix 3) (Appendix 4)(Appendix 5)

There was an obvious divide between risk of bias of RCTs and nRCTs with the RCTs generally at low risk for most domains although for some domains there was insufficient information to be make a judgement (Appendix 2). The nRCTs were at high risk from not being randomised and in some studies there was a suggestion of health professional choice in allocation and as, with the RCTs, information was sometimes lacking. Risk of bias of individual studies is detailed below in the relevant section.

The AMSTAR ratings of the systematic reviews was generally good although some reviews did not list details of excluded studies, included studies of high risk of bias and did not perform publication bias analysis. (Appendix 3)

Paramedic practitioner/emergency care practitioner (PP/ECP) interventions (Appendix 4)

Three studies were identified [10-12] and no relevant recent systematic reviews.

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A cluster RCT (Mason 2007), compared PPs with additional training (n=1469) with standard PPs (n=1549) in assessing and treating elderly people following 999 calls with the aim of measuring subsequent emergency care.[10] Similarly, two more recent nRCT investigated the role of ECPs in avoiding ED) attendance/admissions in elderly populations.[11, 12] Gray 2008 was a case-series study of ECP attendances for elderly patients aged over 65 years with a fall (n=233) compared with historical controls (n=772), and Mason 2012 was a cluster controlled study of enhanced ECP care for five care homes (n=256) compared with standard care in five other care homes (n=201). Risk of bias was low for all the domains of the cluster RCT and both of the nRCT were at high risk due to lack of randomisation.

In the cluster RCT, all primary outcomes comparing the intervention with the control group were improved: relative risk of ED attendance within 28 days (RR 0.72 (0.68, 0.75)), relative risk of hospital admission within 28 days (RR 0.87 (0.81, 0.94)), being very satisfied with care (RR 1.16 (1.09, 1.23)) and mean total episode duration in hours (-42.2 (-59.5,-25.0)) with a reported $p<0.001$ for all.[10] The secondary outcome of mortality was comparable between groups, but intervention patients had a greater number of subsequent unplanned contacts with secondary care at 28 days (330 vs. 259 $p<0.01$).

The two nRCTs reported a greater reduction in admissions when comparing the intervention with normal ECP practice but these results are of limited use due to the high risk of bias of the studies.[11, 12]

None of the studies of PP/ECP interventions provided details of cost data or cost-effectiveness analysis.

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Emergency department (ED) interventions (Appendix 4)

The searches identified one RCT (Sun 2014) which was assessed to be at low risk of bias, and two nRCT (Benaiges 2014, Salvi 2008) in which the risk of bias was high for several domains including randomisation.[13-15] No relevant, recent systematic reviews were identified.

Sun and colleagues conducted a RCT in which patients attending ED with syncope were randomised to receive either a syncope protocol in an observation unit (n=62) or usual care (n=62).[13] where the maximum stay in the observation unit could not exceed than 24 hours.

In terms of primary outcomes, patients randomised to the intervention spent less time in hospital at the index visit (29 vs. 47 hours p<0.001) and were less likely to be admitted to hospital (RR 0.16 (95% CI 0.09, 0.29) p<0.001). There were no differences in the secondary outcomes of serious events, quality of life (QoL) or satisfaction with care between groups. A reduction in costs was reported but no formal statistical comparison was performed (index visit US$1400 vs. 2420, 30 days US$1800 vs.2520 (2011 data)).

The first of the two nRCT compared usual care with treatment in a 'day hospital' for hyperglycaemic crisis from which the main result was improved readmission rates and associated costs (Benaiges 2014), whilst the second nRCT compared a specialist geriatric ED intervention with a standard ED procedure (Salvi 2008) but without evidence of any differences in outcome and had significant differences in baseline demographic data. [14,15]

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Community hospital (CH) interventions *(Appendix 4)*

Two RCTs were identified describing a community hospital (CH) intervention as an alternative to acute hospital (AH) care[16-19] and no relevant, recent systematic reviews.

Both RCTs were at low risk of bias overall. In the RCT by Vicente, participants were randomised following triage at home to either go to a CH (n=410) or to the ED (n=396).[16] The data presented were limited. The authors reported that the nurse attending the patient at home sent 90 intervention participants to the CH (primary outcome) although six of those individuals were subsequently transferred from the CH to the ED (secondary outcome). There were no formal statistical analyses nor were cost data presented.

The Garåsen RCT compared CH care (n=72) to AH care (n=72) and was published over three separate papers. [17-19] There was no distinction between primary and secondary outcomes. At 26 weeks, there were fewer readmissions in the CH group versus the AH group (19% vs. 36%, p=0.02) and more people receiving no care (25% vs. 10%, p=0.01). At 12 months, there were fewer deaths in the CH group (18% vs. 31%, p=0.03) although the observation period was considerably longer in the CH group (335.7 vs. 292.8 days, p=0.01). Total cost of treatment was less in the CH group compared with those receiving AH care NOK 39,650 ((95% CI kr 30 996-48,304) versus NOK 73,417 (95% CI NOK 52 992-93,843)) data collected 2003-2005 (p = 0.002). Average health services costs per patient/day for the entire observation period was NOK 606 (95% CI £ 450- 761) in the CH group compared to NOK 802 (95% CI NOK 641-962) in the AH group (p = 0.026).

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Hospital-at-Home (HaH) interventions (Appendix 4)

Eight of the HaH studies were focused on specific conditions: heart failure (n=3), chronic obstructive pulmonary disease (n=1), pulmonary embolism (n=1), pneumonia (n=1), stroke (n=1), and uncomplicated diverticulitis (n=1). [20-28] The remaining three HaH studies recruited older participants with a range of conditions, and two of these recruited from residential homes.[29-33] All the specific condition studies were included in recent (2010-2016) systematic reviews [34-40] but no relevant reviews for the older participants with a range of conditions were identified.

Heart failure (HF)

Three RCTs were identified on HaH for HF and their results published in four separate papers.[20-23] These studies were included in two previous reviews of HaH one which focused on HF (Quaddoura 2015).[34,35] This review used the Cochrane risk of bias tool and described the overall quality of the RCTs as modest. The AMSTAR rating of the review highlighted a lack of description of excluded studies and the combination of different QoL measures in meta-analysis.

In the Quaddoura systematic review the patients were randomised to either HaH or AH within the ED and the primary outcomes of the review were hospital readmissions and mortality. HaH increased time to first readmission (mean difference (MD) 14.13 days [95% CI 10.36, 17.91] p=0.015 using data from two RCTs (n=132).[22-23] although there was no strong evidence of an effect on the rate of readmission (RR 0.68 [0.42, 1.09]) using data from two RCTs (n=172).[20,22] This is a sizeable reduction, but consistent with chance in a data set of this size. An improvement was reported in health-related QoL at both 6 and 12 months

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(standardized MD (SMD) -0.31 [-0.45 to -0.18]; SMD -0.17 [-0.31 to -0.02] respectively). HaH was comparable to AH care on all-cause mortality (RR 0.94 (0.67, 1.32)) using data from all three RCTs. These studies also showed a significant reduction in costs for the index treatment period (p<0.001). Two trials[20,23] reported lower costs in the HaH group at 12 months, although the difference was not statistically significant in one of the studies.[20] When the authors of this particular review calculated total costs for these two trials, both indicated a cost reduction for HaH compared to AH care.

Chronic obstructive pulmonary disease (COPD)

An RCT by Ricauda was published in 2008 and was also included in two recent systematic reviews - one focusing on COPD and one more generally on HaH.[24,35,36] The high quality COPD review included eight RCTs, one of which described HaH in an early discharge setting, plus the Ricauda trial and six which were published prior to our 2005 inclusion date.

The Ricauda RCT compared HaH (n=52) with AH (n=52) and was conducted with low risk of bias. The primary outcomes were hospital readmission and mortality rates at 6 months. The secondary outcomes included a range of depression, functional, cognitive and nutritional measures as well as costs.

The study showed that there were fewer hospital readmissions for HaH patients compared to AH patients at 6 months (42% vs 87%, p=0.001) although HaH patients had a longer length of stay than those in the AH group (15.5 SD±9.5 vs 11.0 ±SD 7.9 days, p=0.01). Whilst HaH patients experienced improvements in depression and QoL scores during the study, there was no evidence of difference between the two

groups for these outcomes at 6 months. Cumulative mortality at 6 months was comparable between groups (20.2%).

All patients discharged from HaH completed the care programme at home, whereas 11.5% of AH patients continued their care in a long-term facility after hospital discharge, with an average daily cost of $174.7 for a mean period of 25 ±8.7 days. Overall - on a cost per patient per day basis - HaH care was less expensive than that given to the AH group ($101.4 ± 61.3 vs $151.7 ±96.4, p=0.002). This RCT reflected the results of the published systematic review.[36]

Pulmonary embolism

Our review identified one published nRCT of HaH (Rodriguez-Cerillo 2009) for patients with pulmonary embolism which was also included in a recent systematic review with seven other observational studies (Vinson 2012).[25,37] The high quality review concluded that the overall incidence of mortality at 90 days was very low.

The nRCT compared HaH (n=30) with AH (n=31) and was at high risk of bias overall.[25] No distinctions between primary and secondary outcomes were made. Mean length of stay was not statistically different comparing HaH with the AH group (8.9 days (7–14 days) vs. 10.6 days (6–20 days)). No patients treated at home required unexpected return to hospital during admission. There was no major bleeding, thrombosis or death in either group at 90 days in the nRCT. [25] There were no cost data reported.

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Pneumonia

Our review identified one RCT (Carratala 2005) published and included in a recent systematic review (Chalmers 2011) which also described a further five studies comprising a variety of designs).[26,38] The RCT compared HAH (n=110) with AH (n=114) and was at low risk of bias. The primary outcome was the percentage of patients with an 'overall successful outcome' according to seven predefined criteria [26] whilst secondary outcomes were patients' QoL and satisfaction.

An overall successful outcome was achieved in 83.6% of HaH patients and 80.7% of AH patients (absolute difference 2.9% [95% CI, 7.1-12.9]). Subsequent hospital admissions were comparable between groups (6.3 vs. 7.0%). More HaH patients were satisfied with their overall care (91.2 vs. 79.1%; ab 12.1% [CI, 1.8 to 22.5%]). Reported QoL scores were comparable between groups as was the percentage of patients with adverse drug reactions (9.1 vs. 9.6%), medical complications (0.9 vs. 2.6%), and overall mortality (0.9 vs. 0%) for HAH and AH patient groups respectively. There were no cost data presented. This RCT data reflects the result of the systematic review by Chalmers 2011. [38]

Stroke

One RCT on HaH for stroke patients (Kalra 2005) was published and also included in two previous systematic reviews.[27,35,39] This RCT was at low risk of bias. The primary outcome measure was death or institutionalisation at one year. This three-arm study randomised patients into care on a stroke unit (SU) (n=152), care in a general ward (GW) with stroke expert advice (n=152) and HaH with stroke expert advice (n=153) within 72 hours after recruitment in the ED department.

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Mortality and institutionalisation at one year were lower in the SU group compared with either the GW (14 vs. 30%, $p < 0.001$) or HaH groups (14 vs. 24%, $p=0.03$). Significantly fewer patients cared for on the SU died compared with those in the GW group (9 vs. 23%, p = 0.001). The SU group showed greater improvement on basic activities of daily living compared with the other two groups (change in Barthel Index 10 vs. 7, $p < 0.002$). QoL at three months was significantly better in SU and HaH patients. There was greater dissatisfaction with care in the GW group compared with SU or HaH groups. The total costs of stroke care per patient over 12 months (data collected 2005-2008) were £11,450 for the SU group, £9527 for GW group and £6840 for HaH group.

Uncomplicated diverticulitis

Our systematic review found one nRCT(Rodriguez-Cerrillo 2013).[28] This study was also included in a recent, moderate quality integrative review on admission-avoidance HaH services.[40] This nRCT compared HaH (n=34) with AH (n=18) for patients with uncomplicated diverticulitis and was, overall, at high risk of bias with no defined primary or secondary outcomes were defined. No statistical detail was provided about any of the data presented. None of the patients treated at home were transferred to the acute hospital. The mean length of stay in the intervention group was 9 days, compared with 10 days in AH. HaH treatment was associated with a cost reduction of €1368 per patient.

Older population with acute medical problems

There were three studies identified published over five papers[29-33] and no relevant recent systematic reviews. One nRCT recruited acutely ill older persons and was published across three separate papers (Leff 2005, main publication).[29-31] This nRCT

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compared HaH (n=169) with AH (n=286) with the majority of patients being identified the morning after admission. The study was at high risk of bias.[29] There was no distinction made between primary and secondary outcomes. Patients treated with HaH had a shorter length of stay compared with those given AH care (3.2 vs. 4.9 days, p =0.004). The mean treatment cost was lower for HaH care than for acute hospital care ($5081 vs. $7480, p< 0.001). Eight weeks after admission, there were no differences in the use of health services between HaH and AH patients in terms of ED visits, (0.23 (SD 0.66) 0.22 (SD 0.57)) or readmission (0.28 (SD 0.59) 0.27 (SD 0.55)).

The nRCT by Crilly 2010 recruited elderly nursing home patients presenting at ED but who were willing to receive care back in their nursing home (n=62) and compared these with historical control care home patients who had been hospitalised (n=115). The study was at high risk of bias [32] and no primary outcomes were specified. Intervention participants experienced a longer time in ED than those who had been admitted into hospital (9.94 vs. 7.01 hours p=0.005) but required less time being subsequently cared for (2.19 vs. 6.2 days p<0.001). Overall, the length of an episode of care in days (9.56 (1.26) vs. 6.20 (0.59) days, p=0.14) and the number of readmissions within 28 days (11.3 vs. 11.3, p=0.99) were not statistically different between the two groups. There were no mortality or cost data presented.

The nRCT by Lau 2013 assessed residents of a care home presenting at ED who were subsequently treated back in their care home (n=95) and compared data with historical hospital controls i.e. not from care homes (n=167).[33] No primary outcomes were specified and the study was at high risk of bias. Length of stay was significantly shorter for those in the intervention group compared with the controls (2.0 vs. 11.0

days p<0.001) although mortality (11 (11.6%) vs. 20 (12.0%), p=0.924) and readmission rates (39 (41.1%) vs. 68 (40.7%), p=0.963) at 6 months were comparable between groups. There were no cost data presented.

***Characteristics of those older patients for whom the decision to admit to hospital may be unclear (*Appendix 6)**

Fifteen of the studies included in our systematic review recruited a population with a mean age of more than 75 years, despite the inclusion criterion specifying those over 65 years. Whilst 9/19 studies specifically stated their recruited population was multi-morbid, it is plausible that all the study populations were and so this is very likely to be a factor which impacts on decision-making in acute medical care. Eight studies specified a particular degree of severity for dementia as an inclusion criterion but, in practice, this is a difficult assessment to make in the acute care context. There were inclusion/exclusion criteria in nine of the studies which specified the importance taking account of an individual's home situation, social support networks and coping abilities as part of the decision-making process.

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Discussion

Summary of principal findings

The findings of our systematic review show that alternatives to acute hospital care at the point of potential admission for people aged over 65 years can be safe, with comparable mortality and clinical outcomes across a range of acute and chronic conditions. They also have the potential to reduce healthcare spending. The exception to the evidence of benefit of HaH is the treatment of stroke patients, who fare much worse with HaH intervention compared to treatment in a stroke unit. The authors of this study suggest that these differences are due to the overall expertise available in the stroke unit as opposed to care given by generic hospital or homecare staff advised by specialised stroke health professionals. It is recommended therefore that in most cases, in line with current NHS practice for stroke, care should to be provided in specialist units.[41] The key features of older patients for whom the decision to admit may be uncertain are age more than 75 years, co/multi-morbidities, dementia, home situation, social support and individual coping abilities.

Comparison with previous literature

As part of our systematic review, any relevant systematic review published in 2010-2016 was included and referred to when discussing the more recent studies. All of these reviews were on the topic of HaH interventions. In addition to being older evidence, some of the previous reviews in contrast to our own included a number of uncontrolled observational studies. Some also included studies in which HaH interventions were applied in the non-emergency or post-discharge settings. By contrast, our systematic review focuses on bringing together controlled studies on

alternatives to acute hospitalisation at the point of potential admission for the over 65s.

Clinical and research implications

For health professionals, making a decision to admit an older patient can prove very difficult. Decision-making for each individual patient draws upon a range of professional experience and expertise, and should also be influenced by broader factors such as living conditions and individual/family/carer coping, in addition to care preferences. If alternatives to acute admission are available, health professionals must be confident about using these alternative pathways for their patients[5] and whilst many of the interventions in this review may provide viable alternatives to acute care, they may not exist in some healthcare communities or geographical regions. Nevertheless, our review suggests that where established alternatives to admission exist, clinicians should offer these with a degree of confidence and not assume that hospital admission is always the best or safest option for their patient. Future research should aim to provide more comprehensive evidence of both the clinical and cost effectiveness of a wider range of hospital alternatives for a greater range of health issues, as well as exploring in more detail the determinants and outcomes of decision-making under conditions of uncertainty. Many of the studies included in this review recruited highly defined populations and it would be helpful to understand whether the findings can be replicated in more general patient groups. There is also much to be done to improve the collection of data on patient-related outcomes, carer and health professional acceptability, and costs.

Strengths and limitations of review

Our systematic review was conducted to high methodological standards.[42] The majority of evidence presented is based on HaH services, although this includes

treatment of a wide range of conditions. Whilst not all the included studies were randomised or considered to be at low risk of bias, these issues are clearly highlighted and the included studies cover a variety of alternative approaches to hospital admission. The majority of the included studies offer little or no cost data which makes it difficult to assess the cost-effectiveness of any these alternatives to acute hospital care. Whilst writing our protocol we planned to carry out a meta-analysis on suitable data. However, the data we identified were insufficient, in terms of quantity (i.e. often drawn from a single study), quality (i.e. from nRCT) or homogeneity. Where sufficient data were identified - on HaH for heart failure – an analysis had already been conducted within a previous review.[34]

In conclusion, this systematic review describes and assesses evidence on alternatives to acute care for older patients and shows that many of the options available are safe and appear to reduce resource use.

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Competing interests

None of the authors have any competing interests to declare

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Authors' contribution

ALH Research Fellow and lead systematic reviewer conducting all stages of the review and responsible for the initial draft of paper.

MC Research Fellow with specific expertise in Patient and Public Involvement (PPI) as well as older age community care. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

AH Senior Research Fellow with specific expertise in patient-related outcomes. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

WH Professor with specific expertise in health economics. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

CM Reader with specific expertise in trial design and statistical analysis. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

JB Professor with specific expertise in emergency care. Contributing to discussion as the review progressed. Commenting and editing on the drafts of the paper.

SP Principal Investigator and Professor with specific expertise in primary health care. Third reviewer of data. Commenting and editing on the drafts of the paper.

Data sharing statement

This is a systematic review and all the data we have collected is either in the main text and summary table or in the on-line appendices.

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31.05.17

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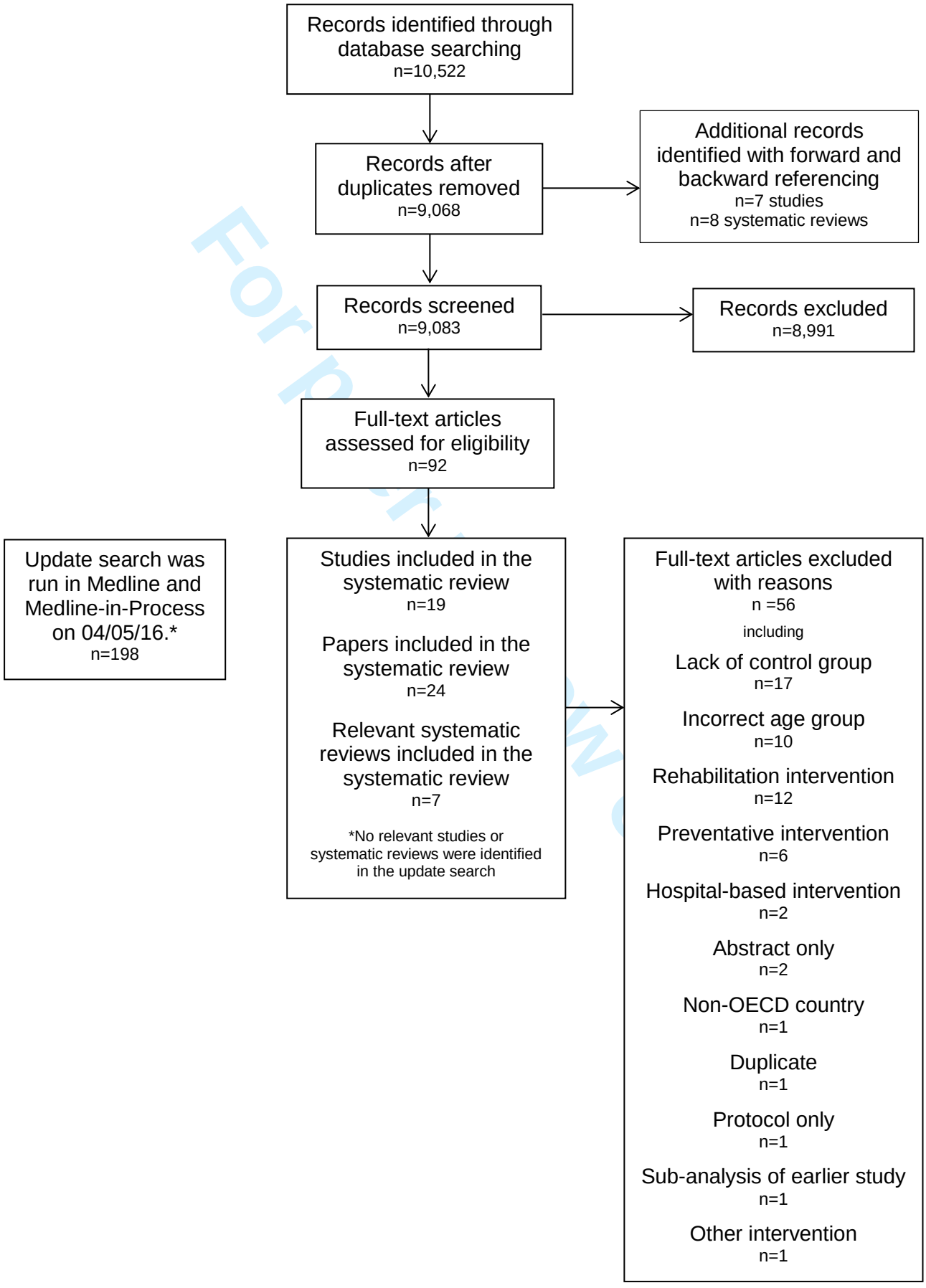
PRISMA flow diagram



Appendix 1: Parent search strategy run in Medline

Database: Medline In-process - current week, Medline 1950 to present

Search Strategy: Run April 24th 2015

1 intervention?ti. or (intervention? adj6 (clinician? or collaborat$ or community or complex or DESIGN$ or doctor? or educational or family doctor? or family physician? or family practitioner? or financial or GP or general practice? or hospital? or impact? or improv$ or individuali?e? or individuali?ing or interdisciplin$ or multicomponent or multi-component or multidisciplin$ or multi-disciplin$ or multifacet$ or multi-facet$ or multimodal$ or multi-modal$ or personali?e? or personali?ing or pharmacies or pharmacist? or pharmacy or physician? or practitioner? or prescrib$ or prescription? or primary care or professional$ or provider? or regulatory or regulatory or tailor$ or target$ or team$ or usual care)).ab. (178760)

2 (pre-intervention? or preintervention? or "pre intervention?" or post-intervention? or postintervention? or "post intervention?").ti,ab. (11719)

3 (hospital$ or patient?).hw. and (study or studies or care or health$ or practitioner? or provider? or physician? or nurse? or nursing or doctor?).ti,hw. (747131)

4 demonstration project?.ti,ab. (2027)

5 (pre-post or "pre test$" or pretest$ or posttest$ or "post test$" or (pre adj5 post)).ti,ab. (72037)

6 (pre-workshop or post-workshop or (before adj3 workshop) or (after adj3 workshop)).ti,ab. (653)

7 trial.ti. or ((study adj3 aim?) or "our study").ab. (697929)

8 (before adj10 (after or during)).ti,ab. (375455)

9 ("quasi-experiment$" or quasiexperiment$ or "quasi random$" or quasirandom$ or "quasi control$" or quasicontrol$ or ((quasi$ or experimental) adj3 (method$ or study or trial or design$))).ti,ab,hw. (107858)

10 ("time series" adj2 interrupt$).ti,ab,hw. (1212)

11 (time points adj3 (over or multiple or three or four or five or six or seven or eight or nine or ten or eleven or twelve or month$ or hour? or day? or "more than")).ab. (10245)

12 pilot.ti. (43282)

13 Pilot projects/ (86631)

14 (clinical trial or controlled clinical trial or multicenter study).pt. (644558)

15 (multicentre or multicenter or multi-centre or multi-center).ti. (31588)

16 random$.ti,ab. or controlled.ti. (809402)

17 (control adj3 (area or cohort? or compare? or condition or design or group? or intervention? or participant? or study)).ab. not (controlled clinical trial or randomized controlled trial).pt. (440969)

18 Aged/ (2394306)

19 "Aged, 80 and over"/ (647729)

20 older adults.mp. (38411)

21 elderly adults.mp. (2417)

22 over 65 years.mp. (3421)

23 virtual ward.mp. (12)

24 intermediate care.mp. (1478)

25 Crisis response.mp. (103)

26 Crisis resolution.mp. (99)

27 reablement.mp. (12)

28 re-ablement.mp. (11)

29 hospital care at home.mp. (14)

30 hospital-at-home.mp. (289)

31 home hospital.mp. (150)

32 medical day hospital care.mp. (2)

33 day hospital.mp. (2435)

34 out-patient facility.mp. (13)

35 Domiciliary care.mp. (247)

36 intermediate services.mp. (7)

37 Intermediate Care Facilities/ (639)

38 Home Care Services, Hospital-Based/ (1662)

39 Home Health Nursing/ (58)

40 Home Nursing/ (8049)

41 admission avoidance.mp. (56)

42 outreach program.mp. (677)

43 hospital outreach.mp. (27)

44 nursing-led units.mp. (3)

45 hospital in home.mp. (8)

46 hospital in the home.mp. (123)

47 medical home care.mp. (39)

48 Crisis intervention service.mp. (31)

49 Geriatric emergency management practice model.mp. (1)

50 day unit.mp. (169)

51 Day Care/ (4670)

52 day centre.mp. (170)

53 comprehensive elderly care.mp. (2)

54 Substitutive care.mp. (1)

55 shared care.mp. (916)

56 guided care.mp. (69)

57 home-based versus hospital-based.mp. (11)

58 home hospitalisation.mp. (28)

59 rapid response team.mp. (515)

60 rapid response nurse.mp. (2)

61 Hospitals, Community/ (10479)

62 *Ambulatory Care/ (15963)

63 *Health Services for the Aged/ (12112)

64 or/1-17 (3278427)

65 or/23-63 (57831)

66 or/18-22 (2428347)

67 64 and 65 and 66 (11288)

68 67 not (child/ or infant/ or adolescent/ or maternal health services/) (9807)

69 68 not (case report/ or case study/ or letter/ or editorial/ or expert opinion.mp.) [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (9192)

70 69 not (Algeria$ or Egypt$ or Liby$ or Morocc$ or Tunisia$ or Western Sahara$ or Angola$ or Benin or Botswana$ or Burkina Faso or Burundi or Cameroon or Cape Verde or Central African Republic or Chad or Comoros or Congo or Djibouti or Eritrea or Ethiopia$ or Gabon or Gambia$ or Ghana or Guinea or Keny$ or Lesotho or Liberia or Madagasca$ or Malawi or Mali or Mauritania or Mauritius or Mayotte or Mozambiq$ or Namibia$ or Niger or Nigeria$ or Reunion or Rwand$ or Saint Helena or Senegal or Seychelles or Sierra Leone or Somalia or South Africa$ or Sudan or Swaziland or Tanzania or Togo or Ugand$ or Zambia$ or Zimbabw$ or China or Chinese or Hong Kong or Macao or Mongolia$ or Taiwan$ or Belarus or Moldov$ or Russia$ or Ukraine or Afghanistan or Armenia$ or Azerbaijan or Bahrain or Cyprus or Cypriot or Georgia$ or Iran$ or Iraq$ or Israel$ or Jordan$ or Kazakhstan or Kuwait or Kyrgyzstan or Leban$ or Oman or Pakistan$ or Palestin$ or Qatar or Saudi Arabia or Syria$ or Tajikistan or Turkmenistan or United Arab Emirates

or Uzbekistan or Yemen or Bangladesh$ or Bhutan or British Indian Ocean Territory or Brunei Darussalam or Cambodia$ or India$ or Indonesia$ or Lao or People's Democratic Republic or Malaysia$ or Maldives or Myanmar or Nepal or Philippin$ or Singapore or Sri Lanka or Thai$ or Timor Leste or Vietnam or Albania$ or Andorra or Bosnia$ or Herzegovina$ or Bulgaria$ or Croatia$ or Estonia or Faroe Islands or Greenland or Liechtenstein or Lithuani$ or Macedonia or Malta or maltese or Romania or Serbia$ or Montenegro or Slovenia or Svalbard or Argentina$ or Belize or Bolivia$ or Brazil$ or chile or Chilean or Colombia$ or Costa Rica$ or Cuba or Ecuador or El Salvador or French Guiana or Guatemala$ or Guyana or Haiti or Honduras or Jamaica$ or Nicaragua$ or Panama or Paraguay or Peru or Puerto Rico or Suriname or Uruguay or Venezuela or developing countr$ or south America$).ti,sh. (8719)

71 admission*.ab. (140603)

72 hospital*.ab. (747796)

73 71 or 72 (804011)

74 70 and 73 (3851)

75 limit 74 to yr="2005 -Current" (1880)

76 remove duplicates from 75 (1829)

Appendix 2: EPOC Risk of bias

Paramedic (PP) / emergency care practitioner (ECP) interventions

Study: Mason 2007 RCT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'We used cluster randomisation to reduce the risk of contamination (practice in the control group being influenced by the presence of the paramedic practitioner in the community) and to allow service level, rather than individual patient level, evaluation of the intervention. Weeks were randomised before the start of the study (to allow for rostering of the paramedic practitioners) to the paramedic practitioner service being active (intervention) or inactive (control), when the standard 999 service was available'
Was allocation adequately concealed?	Low risk	'Episode of care with some form of centralised randomisation scheme'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Flow of patients through trial was presented and intention-to-treat analysis used
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Majority of outcomes were objective but there was one about satisfaction with service i.e. subjective
Was study adequately protected against contamination?	Low risk	'We used cluster randomisation to reduce the risk of contamination (practice in the control group being influenced by the presence of the paramedic practitioner in the community) and to allow service level, rather than individual patient level, evaluation of the intervention'.
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Gray 2008 historical controls - older people with falls

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'From January to April 2006 inclusive, all the patients seen by the ECP service who had rung 999 with a diagnosis of either breathing difficulties or an elderly patient (.65 years of age) with a fall were reviewed.' 'Comparison data were taken from January to April 2005 inclusive for attendances to the same ED for patients with the same criteria as above seen by non-ECP ambulance service personnel'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	Unclear risk	No details given other than 'elderly patients >65yrs with a fall'
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were all objective
Was study adequately protected against contamination?	Low risk	Different data collection time-periods were reported for each group
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Only used half of the study population

Study: Mason 2012 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Potential 'intervention' trust sites were selected on the basis of their heterogeneity of service delivery of ECP care. 'Control' trust sites that did not employ ECPs, but were in close geographical proximity (i.e. within the same or in a neighbouring county) and which offered the same service configurations as the intervention trusts, were then selected'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. ED attendance
Were baseline characteristics similar?	High risk	For the care home subgroup, figures were given on selected baseline characteristics but no formal comparison appeared to be made. On face value, clinical characteristics were not balanced e.g. adult medical 30 vs.41%, adult trauma 46 vs.13%
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were all objective
Was study adequately protected against contamination?	Low risk	Intervention and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Emergency Department (ED) interventions

Study: Sun 2014 RCT - syncope

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'Patients were block randomized (n=4) by site in a 1:1 ratio to either the observation protocol or routine inpatient admission'
Was allocation adequately concealed?	Low risk	'A computer generated the study arm assignment at randomization, and no research personnel had advance knowledge of study arm assignment. We could not blind this health service intervention to patients, providers, or research personnel.'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. inpatient admission rates
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Flow chart of participants provided and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Low risk	Outcome measures were objective but one secondary outcome - participant satisfaction – was subjective
Was study adequately protected against contamination?	Unclear risk	Treatment and control were allocated and delivered in same location so possible for participants to swap allocation
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Salvi 2008 CT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Trained research assistant (VM) screened patients presenting to the ED for Monday to Friday from 9:00 a.m to 6:00 p.m using a standard information sheet explaining the study protocol to patients and proxies'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of initial admissions
Were baseline characteristics similar?	High risk	Intervention and control groups were unbalanced – age, 78.1(7) vs.82.5(7.2) p<0.001, female 47 vs. 68% p=0.004, married 70 vs. 40% p<0.001, SPMSQ 2.5(3.3) vs. 5.2(4.2) p<0.001, ADL4.3(2) vs. 3.2(2.5) p=0.001
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Unclear risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Benaiges 2014 CT - hyperglycaemia

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'Patients were assigned to the DH group if they were admitted to hospital within DH opening hours (weekdays from 8:00 a.m to 4:00 p.m); otherwise they were treated in the emergency department and subsequently hospitalized'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of ER visits
Were baseline characteristics similar?	Low risk	Baseline characteristics of treatment and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	'Patients were treated with same protocol for both DH and CH' so contamination was possible
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Community hospital interventions

Study: Vicente 2014 RCT

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'The dispatchers at the EMCC randomized older adults into the study. A sealed envelope randomization procedure was initiated when the dispatcher received the incoming call and identified the participant as an individual aged 65 who resided in the specified geographical area and was assigned a priority level 2 or 3, and the call occurred between 8:00 a.m. and 10:00 p.m'
Was allocation adequately concealed?	Low risk	'The envelope contained the name of the EMS Company 1 or the name of the EMS Company 2. There was an equal chance (1:1) of being assigned to either of the ambulance companies'
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of individuals sent direct to community hospital
Were baseline characteristics similar?	High risk	There was a difference in the priority level when ambulance sent out (% individuals) – Level 1) 1.6 vs. 0%, Level 2) 59 vs. 47%, Level 3) 39 vs.53%, p=0.001
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	Separate sealed envelope opened for each individual case
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Garasen 2007/8 ab RCT - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'When an eligible patient was identified and accepted for inclusion, a blinded randomisation was performed by the Clinical Research Department using random number tables in blocks to ensure balanced groups'
Was allocation adequately concealed?	Low risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. number of readmissions for index disease
Were baseline characteristics similar?	Unclear risk	Baseline characteristics of intervention and control groups were described but no formal comparison reported
Were incomplete outcome data adequately addressed?	Unclear	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcome measures were objective
Was study adequately protected against contamination?	Low risk	Participants were allocated using a clear process but 8 individuals originally assigned to CH were later assigned to GH
Was study free from selective outcome reporting?	Low risk	All outcomes described in methods section were reported in results section plus 12-month data was used in Garasen 2008
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH) interventions: heart failure

Study: Patel 2008 pilot RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Open pilot RCT
Was allocation adequately concealed?	Unclear risk	Used 'random number generator under direction of specialist nurse or hospital admission staff' but no further detail provided
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since majority of outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and small differences seen in gender, education and two particular co-morbidities
Were incomplete outcome data adequately addressed?	High risk	Flow of patients was described although description of analysis was lacking
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Unclear risk	Difficult to understand the description of outcomes in methods section but all were reported in results section
Was study free from other risks of bias?	Unclear risk	Description of analysis and results was possibly too assertive for a feasibility study

Study: Mendoza 2009/Garcia-Soleto 2013 RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'Randomly assigned (1:1) to one of the intervention groups according to an externally generated sequence, which was hidden from the clinicians until the patient had given consent to participate'
Was allocation adequately concealed?	Low risk	As above
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but functional status and health-related QoL were similar
Were baseline characteristics similar?	Low risk	Baseline characteristics of intervention and control groups were reported and similar
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was described and 'per protocol' analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study: Tibaldi 2009 RCT - heart failure

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	'By the use of a set of computer-generated random numbers in a 1:1 ratio. The allocation sequence was unknown to any of the investigators and was contained in a set of sealed envelopes, each bearing on the outside only the name of the hospital and a number, which was opened after the acceptance of the patient'
Was allocation adequately concealed?	Low risk	Participants were enrolled within 12-24 hours of ED admission by research assistants, masked to both allocation and hypotheses being tested
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but depression, function and nutrition measures were similar
Were baseline characteristics similar?	Unclear risk	Baseline characteristics of intervention and control groups were reported and heart rate was significantly different p=0.006
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial described and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail available
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH): COPD

Study: Ricauda 2008 RCT - COPD

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Patients were randomised using a set of computer-generated random numbers in a 1:1 ratio.
Was allocation adequately concealed?	Low risk	Allocation sequence was unknown to any of the investigators and kept in a set of sealed envelopes, each bearing on the outside only the name of the hospital and a number. After acceptance of a patient, the ED nurse coordinator, who was not involved in the study, opened the appropriately numbered envelope
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process but clinical outcomes e.g. depression were similar
Were baseline characteristics similar?	Low risk	Recorded in DE table
Were incomplete outcome data adequately addressed?	Low risk	Drop outs/loss-to-follow-up were recorded and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	Single-blind study since patients were aware of the treatment assignment although physicians and nurses evaluating patients were blinded to the patient's allocation
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Hospital-at-Home (HAH): Pulmonary embolism

Study: **Rodriguez-Cerillo 2009 nRCT - non-massive pulmonary embolism**

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	nRCT
Was allocation adequately concealed?	High risk	nRCT
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics of treatment and control groups were reported and only difference was prior thromboembolic disease, with these cases all being allocated to hospital
Were incomplete outcome data adequately addressed?	High risk	No patient flow or analysis was described
Was knowledge of allocated interventions adequately prevented during study?	High risk	nRCT
Was study adequately protected against contamination?	Low risk	Clinical decision-making at study entry and any subsequent changes were recorded – although none made in practice
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	High risk	Reported some 'external' decision-making

Hospital-at-Home (HAH): Pneumonia

Study: Carratala 2005 open RCT - pneumonia

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Randomisation was performed by using a computer-generated random code with a block size of 10
Was allocation adequately concealed?	Low risk	Randomisation was stratified by hospital site, and the random code was held centrally, in a sealed envelope, by the clinical epidemiologist. In the emergency department, the infectious disease consultant (in most cases not a study investigator) opened sealed, sequentially numbered opaque envelopes to randomly assign patients who had provided written informed consent and met the study criteria
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Detailed in DE table
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was reported and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	Trial was described as 'unblinded '
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Unclear risk	Lack of blinding in terms of assessment could be problematic

Hospital-at-Home (HAH): Stroke

Study: Kalra 2005 RCT - stroke

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	Low risk	Randomisation was not stratified and was undertaken using the block randomisation technique. This ensured that the number of patients allocated to the stroke unit or to domiciliary services at any one time did not exceed their capacity
Was allocation adequately concealed?	Unclear risk	Randomisation was conducted in blocks of 30 in an office remote from patient treatment areas, so that it would not be possible for those enrolling patients to guess allocation for the vast majority of subjects
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Baseline characteristics with regard to stroke type, severity, level of impairment and initial disability were well-matched across the three groups
Were incomplete outcome data adequately addressed?	Low risk	Patient flow through trial was reported and intention-to-treat analysis performed
Was knowledge of allocated interventions adequately prevented during study?	Unclear risk	No detail provided
Was study adequately protected against contamination?	Unclear risk	Patients were brought to hospital from domiciliary care if that was considered to be clinically appropriate
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	High risk	In order to ensure that participants were treated in the most appropriate setting, swapping of groups was possible

Hospital-at-Home (HAH): Uncomplicated diverticulitis

Study: Rodriguez-Cerrillo 2013 nRCT - uncomplicated diverticulitis

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	nRCT
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Low risk	Mostly not relevant since outcomes were related to process
Were baseline characteristics similar?	Low risk	Very limited details provided about age, gender and presenting complaint
Were incomplete outcome data adequately addressed?	High risk	No flow of patients was given and only basic analysis reported
Was knowledge of allocated interventions adequately prevented during study?	High risk	No detail provided
Was study adequately protected against contamination?	Low risk	Treatment and control were delivered in different locations
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Unclear risk	Both analysis and reporting of results were limited

Hospital-at-Home (HAH): Mixed population

Study: Leff 2005/2009 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	'During the acute care hospital observation phase (1 November 1990 to 30 September 2001), eligible patients were identified and followed through usual hospital care.' During the intervention phase (1 November 2001 to 30 September 2002), eligible patients were identified at the time of admission and were offered the option of receiving their care in hospital-at-home rather than in the acute care hospital'
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. time before evaluation
Were baseline characteristics similar?	High risk	Populations differed in measures of poverty, living alone and medication. This was acknowledged but not adjusted for.
Were incomplete outcome data adequately addressed?	Low risk	Intention-to-treat analysis was conducted although there were substantial missing data e.g. in relation to functional status
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective in Leff 2005 (main publication) but Leff 2009 used self-reported i.e. subjective daily activity of living as an outcome
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcomes described in methods section were reported in results section. Whilst there is no mention of activities of daily living in Leff 2005, this outcome was reported in Leff 2009
Was study free from other risks of bias?	Unclear risk	Possible selection bias related to differences in baseline characteristics e.g. functional status

Study: Lau 2003 historical controls

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	Control trial with historical control group
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. palliative care received
Were baseline characteristics similar?	High risk?	There was an imbalance in patient characteristics which may have been due to recruitment bias since the provider was responsible for recruiting patients into the trial. There were more dementia patients treated outside of hospital – although presumably their symptoms were 'fairly mild' since more pronounced behavioural problems were excluded from HaH group
Were incomplete outcome data adequately addressed?	Unclear risk	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Study name: Crilly 2010 'quasi experimental' - older population with mixed conditions

Bias	Authors' judgement	Support for judgement
Was allocation sequence adequately generated?	High risk	Intervention group included 62 Aged Care Facility (ACF) residents who were enrolled in the Hospital in Nursing home programme during the first 12 months that the programme was operational, from 1 July 2003–30 June 2004. All sample members were ACF residents who presented to the ED and were subsequently admitted to hospital
Was allocation adequately concealed?	High risk	As above
Were baseline outcome measurements similar?	Unclear risk	No baseline measure of outcomes since they were related to receiving intervention e.g. palliative care received
Were baseline characteristics similar?	Low risk	Baseline characteristics of the study and control are reported and similar
Were incomplete outcome data adequately addressed?	Unclear	No reference to missing data or how it might be handled
Was knowledge of allocated interventions adequately prevented during study?	Low risk	All outcomes were objective
Was study adequately protected against contamination?	Low risk	Unlikely that control group received intervention and vice versa. Rather, patients were allocated HaH or admitted and, if HaH was unacceptable they were admitted
Was study free from selective outcome reporting?	Low risk	All outcome measures described in methods section were reported in results section
Was study free from other risks of bias?	Low risk	Nothing obvious

Appendix 3: AMSTAR ratings of systematic reviews

Study	Was an 'a priori' design provided?	Was there duplicate study selection and data extraction?	Was a comprehensive literature search performed?	Was the status of publication (i.e. grey literature) used as an inclusion criterion?	Was a list of studies (included and excluded) provided?	Were the characteristics of the included studies provided?	Was the scientific quality of the included studies assessed and documented?	Was the scientific quality of the included studies used appropriately in formulating conclusions?	Were the methods used to combine the findings of studies appropriate?	Was the likelihood of publication bias assessed?	Was the conflict of interest included?
Caplan 2012	YES	YES	YES	YES	NO excluded studies not listed	NO studies were grouped by medical, surgical, rehabilitation and psychiatric	YES	YES	YES	YES	YES
Chalmers 2011	YES	YES	YES	NO	NO excluded studies not listed	YES but no ages and no direct reporting of participants in either group	YES but not detailed and whilst Cochrane was cited only one RCT involved	YES	UNCLEAR difficult to judge whether combination of study types is commonly accepted	No	YES
Jeppensen 2012 (Cochrane)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Qaddoura 2015	YES	YES	YES	YES	NO excluded studies not listed	YES	YES	NO relatively high risk of bias but all available data used	NO meta-analysis of two RCTs plus combination of different QoL measures from same study in meta-analysis	NO	YES
Shepperd 2016 (Cochrane)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Varney 2014	YES	NO used single reviewer	YES	YES	NO	YES	YES	NO	N/A no data were combined	NO	YES
Vinson 2012	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Appendix 4: description of interventions included in systematic review

Intervention	Description
Paramedic practitioner (PP) / emergency care practitioner (ECP) interventions	PPs/ECPs can be trained to 'assess and treat' or to refer patients with a range of conditions, as part of pre-hospital care. These roles were created in order to provide a more appropriate response to patients needs in emergency and urgent care settings. Their main purpose is to improve the pathway of care and patient experience, particularly by discharging patients at the scene or by referring on to the most appropriate care practitioner, reducing unnecessary emergency department (ED) attendance and avoidable admissions.
Community hospital (CH) interventions	The role of CHs varies between country and health systems but, essentially, their main role is to provide non-urgent i.e. routine or rehabilitative care. However, their role can be extended to provide an alternative to acute hospital (AH) admission for appropriate cases.
Emergency department (ED) interventions	These involve initial assessment in the ED, followed by an extended stay for tests and observation. This extended stay is in a bed closely associated with the ED, if not part of it.
Hospital-at-home (HaH) interventions	HaH services provide acute or sub-acute treatment in a patient's residence for a condition that would normally require admission to hospital. It is also known as 'hospital in the home' and 'home hospitalisation'.
Hospital in nursing/care home (HNCH) interventions	HNCH is as a model of admission avoidance to treat patients living in nursing and residential care homes, working on the same principles as HaH for community-dwelling residents.

Appendix 6: Characteristics of those older patients for whom the decision to admit to hospital may be unclear

Patient characteristics	Studies which include such populations
Age ≥75 years for included patients	15/19 studies Mason 2007 & 2012; Benaiges 2014; Salvi 2008; Garasen 2007; Vincente 2014; Patel 2008; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Kalra 2005; Rodriguez-Cerillo 2013; Leff 2005; Crilly 2010; Lau 2013
Co/multi-morbidities in included patients stated either by number of conditions or multi-morbidity score e.g. Charlson Score	9/19 studies Benaiges 2014; Salvi 2008; Patel 2008; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Carratala 2005; Leff 2005; Lau 2013
Dementia either stated in a) patient demographics or b) used as an exclusion criterion based on severity	a) 2/19 studies Rodriguez-Cerillo 2009; Lau 2013 b) 8/19 studies Mason 2007; Sun 2014; Salvi 2008; Garasen 2007; Mendoza 2009; Tibaldi 2009; Ricauda 2008; Lau 2013
Social care support stated in inclusion/exclusion criteria	3/19 studies Tibaldi 2009; Ricauda 2008; Kalra 2005;
Home situation stated in inclusion/exclusion criteria	7/19 studies Benaiges 2014; Garasen 2007; Mendoza 2009; Ricauda 2008; Rodriguez-Cerillo 2009, 2013; Lau 2013
Individual coping abilities stated in inclusion/exclusion criteria	2/19 studies Patel 2008; Rodriguez-Cerillo 2013

Appendix 5: Detail of included studies

Paramedic/ECP) interventions (n=3)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Mason **2007** **UK**	**Cluster RCT by service** **56 clusters** **Intervention:** paramedic practitioner service n=1469 **Control:** Inactive paramedic practitioner service n=1549	**Inclusion criteria:** Patients aged ≥60yrs recruited from 1 Sep 2003- 26 Sep 2004. Call originated from a Sheffield postcode between 8am-8pm, with a presenting complaint that fell within the scope of practice of the paramedic practitioners. **Exclusion criteria:** **None given** 'If patients were unable to complete questionnaires e.g. because of cognitive impairment or who were unable to read English—we obtained consent for follow-up by review of clinical records only. **Baseline characteristics of participants** Intervention vs. control **Mean age (SD)** 82.6(8.3) vs. 82.5(8.3) yrs **Women %** 72 vs.73% **Living in on own home %** 78vs.78 % **Presenting complaint %** Fall 88 vs.89% Haemorrhage 6 vs.5% Acute medical condition 6vs.5%	A paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner. All identified patients were approached face to face either in the community or in ED for written consent to follow-up. Patients who had more than one eligible episode were recruited only once. The research team independently checked the ambulance service call database at the end of each month for any additional eligible calls not identified These were checked for selection bias but not followed up. Scope of practice of paramedic practitioners: Falls, Lacerations, Epistaxis, Minor burns, Foreign body in ear, nose, or throat, Local anaesthetic techniques, Wound care and suturing techniques, Principles of dressings and splintage, Joint examination, Examination of neurological, cardiovascular, and respiratory system, Examination of ear, nose, and throat, Protocol led dispensing: simple analgesia, antibiotics, tetanus toxoid, Assessment of mobility and social needs, Additional options for referral and requesting investigations, Requests for radiography, Referral processes: emergency department, general practitioner, district nurse, community social services	A paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner in the ED Procedure continued as for intervention	**Relevant measures & outcomes** Primary outcomes ***ED attendance*** ***Hospital admissions within 28 days*** ***Time of call to time of discharge*** ***Patient satisfaction survey including the EQ-5D*** Secondary outcomes ***Subsequent unplanned contact with secondary care at 28 days*** ***Mortality at 28 days***	Intervention vs. control Primary outcomes ***ED attendance (28 days)*** **970 (62.6%) vs. 1286 (87.5%) p<0.001** ***Hospital admissions (28 days)*** **626 (40.4%) vs. 683 (46.5%) p<0.001** ***Mean Time of call (SD) to time of discharge in mins*** **235.1(183.3) vs. 277.8(182.6) p<0.001** ***Patient satisfaction survey including the EQ-5D*** **Very satisfied with care 656 (85.5%)vs.528 (73.8%) p<0.001** Secondary outcomes ***Subsequent unplanned contact with secondary care*** **330(21.3%) vs. 259 (17.6%) p<0.01** ***Mortality at 28days*** 68(4.4%) vs.74(5%) p=0.41

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Gray **2008** **UK**	**COS with historical controls** **Intervention:** Emergency care practitioner **(ECP)** intervention n=233 **Control:** Historical control group from ED n=772	The study included two groups of patients a) those with breathing difficulties & b) elderly patients >65yrs with a fall. The latter only is reported here. **Inclusion criteria:** Elderly patients >65yrs with a fall. **Exclusion criteria:** None given **Baseline characteristics of participants** None given	**Outline of intervention** Jan-April 2006 inclusive, all the patients seen by the ECP service who had rung 999 and were an elderly patient (>65yrs) with a fall were reviewed. Each patient seen by an ECP was searched for in the hospital records for ED attendance or admissions in 72 h and 28 days following attendance by an ECP	**Outline of control** Comparison data taken Jan- April 2005 inclusive for attendances to same ED for patients with the same criteria as above & seen by non-ECP ambulance service personnel. These dates were chosen because, during this time, the ECP service was not tasked to patients with breathing difficulties and Yorkshire Ambulance Service had only 12 operational ECPs during this comparison period compared with 24 whole-time equivalent operational ECPs during the study period	**Relevant measures & outcomes** Outcome on initial contact: ***Treated at and stayed home*** ***ED and or admitted*** At 72hrs & 28 days ***At home*** ***ED attendance*** ***Admission*** **Costs** None	**ECP vs. ED** Outcome on initial contact: ***Stayed at home (PC referral)/went home*** 171 vs. 369 (73% vs. 48% avoidable admission rate) **At 72hr:** 21/171 (intervention grp) attended ED and or were admitted **At 28 days:** A further 19 (intervention grp) attended ED and or were admitted Avoidable admission rate (intervention grp) at 28 days was 56% (17% better) compared to control group p<0.05

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Mason **2012** **UK**	**COS** **Intervention:** Five teams of Emergency Care Practitioners (ECP) n= 256 for care home cohort **Control:** Five usual care providers n=201 for care home cohort	**Inclusion criteria:** Informed consent was obtained from all study participants prior to recruitment. Within each pair of services all patients presenting with emergency or urgent complaints that were eligible to be seen by ECPs and presented to either the intervention or the control services between May 2006 and August 2007 were included in the trial. **Exclusion criteria:** No detail **Baseline characteristics of participants** (no stats given) Care home cohort Intervention vs. control **Mean age** 83.5(10.40 vs. 84.5(8.5) yrs **% Female** 68 vs.66% **Clinical complaint %** Adult medical 30 vs.41 % Adult trauma 46 vs.13 % Elderly falls 23vs.46%	**Outline of intervention** No detail	**Outline of control** No detail	**Relevant measures & outcomes** Using paired services Primary outcomes ***% of patients Discharged following consultation with no further follow up by any health professional*** ***Urgently referred to hospital (both ED or direct admission)*** ***Non-urgently referred to GP or community care*** Secondary outcomes (relevant ones only) ***Episode time from first contact to discharge***	***Discharged with no further follow up by any health professional*** 49.2 vs.12.4% MD 36.8% (95% CI 26.7,46.8) ***Urgently referred to hospital (both ED or direct admission)*** 22.7 vs. 87.6% MD -64.9% (95% CI -71.8 ,.-58.0) ***Non-urgently referred to GP or community care*** 28.1vs. 0% 28.1% (22.6,33.7) ***Episode time from first contact to discharge median in mins (IQR)*** 60 (40,80) vs. 39 (29,58) Time ratio 1.36 (1.24,1.49)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Sun **2014** **USA**	**RCT** **Intervention:** ED observation syncope protocol n=62 **Control:** Normal In-patient admission n=62	**Inclusion criteria:** Patients aged≥ 50 years or older diagnosed with intermediate syncope. **Exclusion criteria** Patients with a serious condition: symptomatic arrhythmias, myocardial infarction, pulmonary embolism, acute pulmonary edema, stroke, severe anaemia or blood loss requiring blood transfusion, sepsis, and major traumatic injury. Also: seizure, head trauma, or intoxication as reason for loss of consciousness; new/ baseline cognitive impairment; do-not-resuscitate or do-not-intubate status; active chemotherapy and inability to speak either English/Spanish. Met high risk criteria. **Baseline characteristics of participants** Observation vs. control Mean(SD) or% **Mean age** 65 (11) vs. 64(11) **% Female** 53 vs. 48 **Syncope index complaint (vs near syncope)** 74vs. 61% **Congestive heart failure** 2vs. 3% **Coronary artery disease** 13vs.8% **Arrhythmia** 8vs.6% **Syncope in previous yr** 16vs.21% **Quality of well-being scale** 0.55(0.15) vs. 0.55(0.14) **Syncope functional status** 29((25) vs.25(26) **Syncope risk score** 0.76 (0.840 vs.0.76 (0.67)	**Outline of intervention** Patients received continuous cardiac monitoring ≥ 12hrs. ≤2 serial cardiac troponin tests approx. 6 hours apart to exclude acute MI. Rest echocardiogram for patients with cardiac murmur, if not performed in previous 6mths. Additional testing as required. Maximum stay in observation unit could not be more than 24hrs. Observation protocol patients who received a diagnosis detailed in exclusion list or had pending tests at 24hrs were admitted **High Risk Criteria** Serious condition identified in the ED, History of ventricular arrhythmia, Cardiac device with dysfunction, Exertional syncope, Presentation concerning for acute coronary syndrome, Severe cardiac valve disease (e.g., aortic stenosis <1 cm2), Known cardiac ejection faction <40% Electrocardiogram findings of QTc>500 mS,pre-excitation, non-sustained ventricular tachycardia, Emergency physician judgment **Intermediate Risk Criteria** No high risk features **AND** No low risk features **AND** Clinical judgment by emergency physician that patient requires further diagnostic evaluation **Low Risk** Symptoms consistent with orthostatic or vasovagal syncope**,** Emergency physician judgment that no further diagnostic evaluation is needed.	**Outline of control** The syncope protocol was not used. Contamination between groups was minimized by being managed in distinct physical spaces by different clinical services. **Intervention delivered by:** No detail	**Relevant measures & outcomes** Primary outcomes ***Inpatient admission rates*** ***Hospital LOS at indexed visit*** Secondary outcomes ***30 day and 6mth serious events*** ***Index and 30 day hospital costs*** ***30 days changes in QoL*** ***30 day patient satisfaction***	***Observation vs. s care*** ***Inpatient admission rates*** **9 (15%) vs. 57 (92%)** **Relative rate 0.16 (95%CI 0.09,0.29, p<0.001)** ***Hospital LOS at indexed visit*** **mean SD (hrs) 29 (15) vs. 47hrs (34) (p<0.001)** ***Serious events*** ***During hospital visit*** Death 0 vs. 0 Arrhythmia 2 vs. 2 Pacemaker insertion 1vs.1 Syncope with bone fracture 2 vs.1 30 days recurrent syncope 1 vs 1 30 day serious outcomes after discharge 2 vs. 0 6mth serious outcomes after hospital discharge 4 vs.5 ***Costs $ (SD)*** At index visit 1,400(1,220) vs.2,420(3,930) Within 30 days 1,800(2,150) vs.2,520(3,980) ***Change in quality of life*** mean SD 0 (0.2) vs. 0.03 (0.18) ***Change in syncope functional status*** -7.6(20.1) vs.-2.4(26.3) ***Patient satisfaction*** 8.9(1.40 vs.9.3(0.9)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Benaiges **2014** **Spain**	**COS** **Intervention:** 'Day hospital' (DH) n=64 **Control:** Conventional hospitalisation (CH) n=36	**Inclusion criteria:** Patients with sustained hyperglycemia (>300 mg/dL) for at least 3 days with or without ketosis **Exclusion criteria** Ketoacidosis (venous pH <7.31 and/or HCO3 <22 mEq), hyperosmolar crisis (glycemia >600 mg/dL and effective plasma osmolarity >320 mOsm/L), unstable hemodynamic status or need for ventilatory support, severe precipitating factors such as acute myocardial infarction, stroke, sepsis, social deprivation, and dependence for four or more activities of daily living (Katz index >D). **Baseline characteristics of participants** **(Stats shown if signif)** DH vs.CH **Age** 80.3(4.8)vs. 80.6(4.6)yrs **Female** 67 vs. 56% **BMI** 26.1(4.9)vs.25.5(5.1) **Katz A&B** 72.2vs.72.2% **Charlson Index** 3.2(2.0)vs. 3.3(1.7) **Family support** 88.1 vs.97.1% **Diabetes duration** 14.4 (8.0) vs. 97.1 yrs Plus other specific diabetes measures	**Outline of intervention** Patients assigned to DH if admitted to hospital within DH opening hours (week days 8 am -4 pm); otherwise they were treated in ED and subsequently hospitalized. After initial treatment of hyperglycemic crisis DH patients were scheduled for follow-up visits at 24, 72 hours, and 7 days to adjust treatment and to complete their diabetes education Patients were treated with same protocol for both DH and CH: this included initial evaluation with a blood test, urinalysis, chest radiograph to rule out underlying infectious disease, and hourly measurement of glycemia and ketonemia. Treatment included hydration as required, an insulin regimen with insulin, and oral carbohydrate intake if glucose levels were less than 250 mg/dL with persistent ketosis. If infection was diagnosed, treatment was initiated. Diabetes education was delivered by specialist diabetes nurse with specific attention paid to dietary advice, physical activity, and recognition of hypoglycemia. Measurement of glycated hemoglobin (HbA1c) and clinical evaluation was scheduled for 3 & 6 mths for patients in both groups	**Outline of control** At hospital discharge, CH patients were scheduled for a one-week follow-up visit in outpatient clinic. **Intervention delivered by:** Unclear but normal outpatient staff	**Relevant measures & outcomes** (no distinguishing between primary and secondary outcomes) At 3 mth follow up ***[No. of mild or severe hypoglycemic episodes]*** ***Readmissions for diabetes or unrelated cause*** ***[Nosocomial complications]*** ***No. of outpatient visits*** ***No. of ER visits*** [outcomes] not detailed as not relevant to our question ***Costs*** ***Initial care*** ***Complementary examinations*** ***Pharmacy*** ***Outpatient visits*** ***Readmissions*** ***Total*** In euros	Mean (SD) DH vs.CH **Readmissions for diabetes (%)** **1(1.6)vs. 5 (13.9)** **P=0.04** Readmission for any cause (%) 4(6.3)vs.7(19.4) p=0.085 **No. of outpatient visits (SE?)** **5.0(2.2)vs. 2.5(2.0)** **p=0.012** No. of ER visits (SE?)? 0.2(0.6)vs.0.2(0.4) P=0.59 **Costs** **Initial care** **580.2(489.1) vs. 2,013.6(790.4) p<0.001** **Complementary examinations** **123.7(276.3) vs. 281.3(188.1) p=0.007** Pharmacy 12.8(95.6)vs. 20.3(24.8) P=0.676 Outpatient visits **116.7(75.3) vs. 56.9(105.7) p=0.003** **Readmissions (total)** **340.8(1190)vs.288.3(916.8)p=0.835** **Total** **1,345.1(793.6) vs. 2,212.4(982.5) p<0.001**

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Salvi **2008** **Italy**	**COS** **(secondary analysis)** **Intervention:** Geriatric ED (GED) n=100 **Control:** Conventional ED (CED) n=100	**Inclusion criteria:** Patients aged ≥ 65yrs were enrolled in June 2006 from the GED and July 2006 from the CED taking care that none presenting to the ED in the course of the study period was recruited again. **Exclusion criteria** Cognitive impairment (a score of ≥5 on the Short Portable Mental Status Questionnaire SPMSQ) and no proxy, Those too ill to respond, Trauma patients **Baseline characteristics of participants** CED vs GED Mean(SD) **Age 78.1(7) vs.82.5(7.20 p<0.001** **Female 47 vs. 68% p<0.001** **Married 70 vs. 40% p<0.001** Living alone 12 vs 14 **Triage code** Urgent/semi-urgent (2/3) 97 vs.90 % Charlson Index 3.3(2.3) vs. 3.4(1.7) **SPMSQ** **2.5(3.3) vs. 5.2(4.2) p<0.001** **ADL4.3(2) vs. 3.2(2.5)** **P=0.001** No differences in profile of diagnosis in ED between groups	**Outline of intervention** No details beyond ED plus observation unit of 6 beds **Intervention delivered by:** No details	**Outline of control** Patients presenting to ED were screened Mon-Fri 9am- 6pm using standard information sheet. Interviews conducted with patients or family member/other for patients with cognitive impairment. Written consent & access to medical records was obtained. patients a underwent a brief geriatric assessment using the Charlson Index, SPMSQ, and ADL before the current event	**Relevant measures & outcomes** ***Mean duration (SD)*** ***No. of initial admissions*** ***LOS in hospital days*** ***Both of above presented as baseline data*** ***No. ED visits at 30 days and 6 mths*** ***Frequent ED return (≥3 visits over 6 mths)*** ***No. hospital admissions at 6mths*** ***ADL at 6mths (defined as functional decline*** ***Mortality at 30 days & 6 mths*** **Costs** None	CED vs. GED ***Mean duration (SD)*** **6.2(4.5) hrs vs. 12.8 (8.5) hrs** **P<0.001** ***No. of initial admissions*** 53 vs.63 p=0.2 ***LOS in days*** 10(6.65) vs. 10.5(7.2) p=0.74 ***No. ED visits*** 30 days 25 vs. 23 visits p=0.88 6months 51 vs. 42 p=0.25 ***Frequent ED return (≥3 visits over 6 mths)*** 11 vs.13 visits p=0.84 ***No. hospital admissions at 6mths*** 36 vs.29 p=0.2 ***ADL*** 20 vs. 20 p=0.34 ***Mortality*** **30 days 8 vs. 5 deaths** **6months 20 vs. 19** Statistically significant at 6mths after adjustment for age, sex, living status, admission at time of recruitment Charlson index, SPMSQ and ADL **p=0.047**

Community hospital (n=2)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Garåsen **2007/8ab** **Norway**	**RCT** **Intervention:** Community hospital (CH) n=72 assigned but 8 went on to GH **Control:** General hospital (GH)admission n=70	**Inclusion criteria:** Patients aged ≥60 years admitted to general hospital due to acute illness or acute exacerbation of known chronic disease Probably in need of in ward care for ≥ 3-4 days Admitted from own homes and expected to return home when care finished. **Exclusion criteria** Severe dementia or a psychiatric disorders needing specialised care 24 hours a day. **Baseline characteristics of participants** **(No stats given)** [including data from n=8 who were assigned CH then went to GH] CH vs.GH **Age** 80.6 (0.8)vs. 81.3(0.8)yrs **Female** 72 vs.61% **Living with spouse** 16 vs. 15 **ADL (SD)** 2.24(0.9) vs. 2.05 (0.7) **Primary diagnosis** **Cardio dis** 31 vs.29% **Infect** 18vs. 23% **Fractures/contusions** 19vs. 17% **Pulmonary disease** 7vs.9% **Neurological** 7 vs.6% **Cancer** 3 vs 6% **Psychiatric** 1vs.0% **Other** 14 vs 11%	**Outline of intervention** On admission to CH the physicians performed a medical examination of the patients and a careful evaluation of available earlier health records from the **admitting general practitioner, the general hospital physicians and the community home care services**. The communication with each patient and his family focusing on physical and mental challenges was also essential to understand the needs and level of care. . Assume from the inclusion criteria that all patients came to the general hospital initially then ' When an eligible patient was identified and accepted for inclusion, a blinded randomisation was performed by the Clinical Research Department at the Faculty of Medicine.' All patients randomised for care at the community hospital were transferred from the general hospital within 24 hours after the time of inclusion to the study and immediately after the time of randomisation.	**Outline of control** The care at different departments at GH and communication with primary health care followed the standard routines through the formal organisation.	**Relevant measures & outcomes** Follow up at 26 weeks & 12 months ***No. of readmission for index disease*** ***Need for community home care*** ***Need for long term nursing home*** ***No. of days in institutions after randomisation [intervention +rehab +readmissions] data is available for separate services*** ***No. of deaths*** ***No. of days before death*** ***No care*** 12 month data in [0273] **Costs** None	CH vs. GH No. (%) At 26 weeks ***No. of readmission for index disease*** **14(19%) vs. 25 (36%) p=0.02** ***Need for community home care*** 38(53%) vs. 44(63%) p=0.37 ***Need for long term nursing home*** 7(10%) vs. 5(7%) p= 0.76 ***No. days in institutions*** 31(95% CI 26.1,34.7) vs.29.8 (95% CI 23.2,36.4) p=0.80 ***No. of deaths*** 9(12.5%) vs14(20%) p=0.15 **No. days before death** 165 (95% CI 154-176) vs. 156 (95% CI 144,165) **No care** **18(25%) vs. 7(10%) p=0.01** 12 month data **No. of deaths** **13(18.1%) vs. 22 (31.4%) p=0.03** **Total observation period** **335.7(95% CI 312.0,359.4) vs. 292.8(95%CI 264.1,321.5) days p=0.01**

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Vicente 2014 **Sweden**	**RCT** **Intervention:** Going to a community-based hospital n=410 **Control:** Going to ED n=396 .	**Inclusion criteria:** No specific information **Exclusion criteria:** No specific information older adults were randomized when they called the emergency number **Baseline characteristics of participants** Intervention vs. control **Mean age (SD)** 81 (8) vs. 81(8) yrs **% Female** 56 vs. 59% **Priority level when ambulance sent out (% individuals)** **1. 1.6 vs. 0%** **2. 59 vs. 47 %** **3. 39 vs.53%** **P=0.001** **Priority level when ambulance arrives at hospital (% individuals)** 1. 7.2 vs.3.6% 2. 39 vs.35% 3.54 vs.61%	**Outline of intervention** The study was conducted over 14 months from Oct 2008 to Dec 2009. Two EMS companies were included in the study. Ambulance personnel at Company 1 had training in and access to the system and tool and could triage eligible individuals to a GW or, a CECC at a CH. By following system and tool & after assessment of the individual's medical situation and care needs, the ambulance nurse was able to decide whether the individual required full ED services or would benefit more from being transported to an assessment at the CH instead. **Delivered by:** The ambulance nurse education are required to have a course of 60 credits includes ≥ 30 credits in Caring Science. The criterion for entering this program is a BSc Caring Science and Nursing. Since 2007, a 1-year Master's Degree & postgraduate Diploma in Specialist Nursing, Prehospital Emergency Care Program has been available.	**Outline of control** Ambulance personnel at Company 2 had no training in the system and tool, and transported all individuals to a full-service ED at a tertiary hospital	**Relevant measures & outcomes** Primary outcome: ***No. of individuals sent direct to CH for either to GW or CECC*** *Secondary outcome:* ***No. of subsequent transfers from CH to ED within 24 hrs*** Calculated as Intention to treat (ITT) and per protocol (pp) analysis **Costs** None	Intervention vs. control ***No. of individuals sent direct to CH for either to GW or CECC*** ITT 90/449 20% (16.6,24) PP 56/273 20.5% (16.1,25.7) ***No. of subsequent transfers from CH to ED within 24 hrs*** ITT 6/90 6.7% (3.1,13.8) PP 4/56 7.1 (2.8,17.0)

Hospital at home for community dwelling older people (n=9)

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Patel 2008 **Sweden** **Heart Failure**	**pilot RCT** **Intervention:** HC Treated at home after >48hrs treatment in ED (n=13) **Control:** CC Treated in hospital as per hospital treatment guidelines (n=18)	**Inclusion criteria:** *Into study* Earlier diagnosed with CHF with diastolic or systolic LVD Deterioration of HF ≥3 days with symptoms of increasing dyspnoea, orthopnoea, weight gain≥2 kg, debuting peripheral oedema or abdominal swelling Clinical signs, e.g., extended jugular vein, leg oedema, tachypnoea, pulmonary rales, ascites and third heart sound. At least one symptom and one sign should be present New York Heart Association class II–IV *for home treatment* It was considered medically safe to treat patients at home if they had a S-Potassium level 3.4-5.5 mmol/L, systolic blood pressure >95 mm Hg, S Creatinine<250 µmol/L & <50% increase from the baseline value during drug adjustment. **Exclusion criteria** Unwillingness to participate Worsening of CHF<3 days Newly onset HF, Pulmonary or pre-pulmonary oedema, Need for monitoring of arrhythmia Other morbidities indicating need for hospitalisation. Living at an institution. Inability to follow instructionsS-Haemoglobinb100 g/L or a decrease of S Haemoglobin>20 g/L S-Creatinine>250 µmol/L S-Potassium>5.5 mmol/L or b3.4 mmol/L S-Troponin T>0.05 µg/L Creatine kinase-MB>5 µg/L ASAT and ALAT>three times above the normal value. Systolic blood pressure>95 mm Hg Heart rate<45 or >110 beats/min **Baseline characteristics of participants** Male n (%) 6 (46)/7 (54) 15 (83)/3 (17) 0.03 Age (years) mean (SD) 77 (10) 78 (8) ns Marital status n (%) Divorced 2 (15) 3 (17) ns Single 1 (8) 2 (11) ns Widowed 7 (54) 5 (28) ns Education n (%) ≥9 years 1 (8) 8 (44) 0.02 ns Weight kg mean (SD) 71 (13) 79 (15) ns NT-proBNP pg/ml (median and interquartile range) 4420 (1690–14350) 9335 (3375–13350) ns LVEF % mean (SD) 36 (13) 33 (12) Preserved ejection fraction CHF n (%) 3 (23) 2 (11) Systolic CHF n (%) 10 (77) 16 (89) NYHA class n (%)II 1 (5.5)III 13 (100) 16 (89) IV 1 (5.5) truncated	**Outline of intervention** Initially treated in the ED for ≥48 h & then sent home. The specialist HF nurses followed a written physician directed care plan including adjusting medications. A cardiologist could be consulted. All patients followed-up one day after returning home by nurse. The patients were visited daily or every other day for 5–7 days as appropriate. The home visits stopped when: (1) was symptomatically stable or improving, (2) had stable or falling weight, (3) had no signs of pulmonary rales and (4) had no oedema above the ankle. Patients could contact nurse by phone in office hours. Nurses at intensive cardiac care unit could be reached by telephone after office hours. A cardiologist was always available for phone consultation ≤1 month after the last home visit, the nurse was available for phone counselling.	**Outline of control** Treated in hospital as per hospital treatment guidelines	**Relevant measures & outcomes** No distinction between primary and secondary outcomes **Clinical status** was documented at 1,4,8& 12 mths **Direct costs** for control group based on compensation paid to hospital and for home care group based on time & activities of nurses & physicians plus lab tests and i.v diuretic episodes **Readmissions** from hospital data (presumably up to 12mths – not listed in methods)	There was no significant difference in clinical events including readmissions adverse events or in HRQL (measured at baseline too). The total cost related to CHF was lower in the HC group after 12 months (p=0.05) detail of costs Euros HC vs. CC Nurse cost 386 (244-1107) vs. N/A Physician 35(19-74) vs. N/A Transport 96953-127) vs. N/A Total cost for care 586 (334-1125) vs. 3277 (2125-5750) Readmissions 0.5(0.8) vs. 0.6 (0.8) ns

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Mendoza 2009 Garcia-Soleto 2013 **Spain** **Heart Failure**	**RCT** **Intervention:** Hospital at home (HAH) care (n=37) **Control:** Inpatient hospital care (IHC) in a cardiology unit (n=34)	**Inclusion criteria:** Patient of 65 years and over With diagnosis and prognosis evaluation of HF since at least 12 months prior to the study NYHA functional class II or III before coming to ED due to exacerbation **Exclusion criteria** Admitted in the preceding 2 months for deterioration of HF or acute coronary syndrome Presence of severe symptoms such as sudden worsening of HF Poor prognosis factors (haemodynamic instability, severe arrhythmia, baseline creatinine above 2.5 mg/dL) No response to treatment in the ED Active cancer, severe dementia, or any other disease at an advanced stage indicating life expectancy of less than 6 months Acute psychiatric diseases, active alcoholism Active pulmonary tuberculosis Those living in a psycho-geriatric institution No guarantee of all-day supervision Absence of a telephone at home or living more than 10 km from the hospital **Baseline characteristics of participants IHC vs. HaH** Women, n (%) 10 (29.4) 19 (51.4) 0.06 Age, mean +SD 79.9+6.3 78.1+6.2 0.20 Admissions for HF in previous year 0.41+0.86 0.65+0.86 0.13 O2 saturation in ED 91.4+5.2 93.2+4.6 0.12 Functional Class NYHA II, n (%) 23 (67.6) 19 (51.4) Functional Class NYHA III, n (%) 11 (32.4) 18 (48.6) 0.16 Atrial fibrillation, n (%) 16 (47) 21 (56.8) 0.49 LVEF ≥45%, n (%) 24 (70) 23 (62.1) LVEF , <45%, n (%) 10 (29.4) 14 (37.8) 0.13 NT-proBNP (pg/mL) 4056+5352 3864+3720 0.86 Charlson index 2.1+1.3 2.5+1.5 0.35	**Outline of intervention** Characteristics of the HaH unit explained whilst still in ED. Given information sheet with contact phone numbers. Within 12–24 h of the ED visit, patients received scheduled & if necessary, urgent visits to their homes from an internal medicine specialist & a nurse, (staff of the HaH unit). If deterioration occurred outside the working hours (8am-9 pm every day of yr), patients & family were instructed to call 112 to explain they were HaH patients. Samples were taken for lab tests and ECGs were performed in patient's home X-ray & echocardiography at hospital was as accessible for HaH patients as for in-patients. Generally all patients were visited daily by a specialist nurse. Patients were visited by a physician daily or every other day depending on condition. Treatment in HaH finished with referral to primary care after recovery or, in case of deterioration or no response to treatment, with transfer to the cardiology ward.	**Outline of control** Patients were admitted to hospital, cardiology ward & were managed by the usual staff of cardiology specialists and nurses, in accordance with guidelines.	**Relevant measures & outcomes** No distinction between primary and secondary outcomes ***Effectiveness*** Necessity to transfer the patient from HaH to IHC during the first admission Mortality due to any cause, re-admission due to HF, or another cardiovascular event (stroke, acute coronary syndrome, and coronary revascularization) during 1 year of follow-up. Functional status -Barthel index Health-related quality of life -SF-36 since first admission up to 12 months later ***Costs*** Cost of the stay Medication, diagnostic tests (electrocardiography, echocardiography, laboratory tests, and chest X-ray), consumables, and transport. visits to HF clinic, primary care physician or ED, as well as re-admissions. For re-hospitalizations, the cost of the admission was estimated as the average cost per day incurred during the first admission for each group.	Clinical outcomes were similar after initial admission and also after the 12 months of follow-up. Death or re-admission due to HF or a cardiovascular event occurred in 19 patients in IHC and 20 in HaH (P=0.88). Changes in functional status and health-related quality of life over the follow-up period were not significantly different. Average cost of initial admission 4502±2153E in IHC and 2541±1334E in HaH (P< 0.001). During 12 months of follow-up, the average expenditure was 4619+7679E and 3425+4948E (P= 0.83) respectively.

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Tibaldi 2009 Italy **Heart Failure**	**single blind RCT** **Intervention:** Physician led - Geriatric Home Hospitalization Service (GHHS; n=48) **Control:** Patients were randomly assigned to the general medical ward (GMW; n=53)	**Inclusion criteria:** ≥75 years with a pre-existing diagnosis of CHF (stage C AHA) & persistent functional impairment indicative of NYHA class III or IV status presenting at hospital ED for acute decompensation (defined)& in need of hospital care. Additional inclusion criteria were appropriate care supervision at home, telephone connection, living in the hospital at- home catchment area, informed consent, at least 1 previous admission for acute CHF, and need for intravenous drug infusion. **Exclusion criteria** New-onset heart failure; absence of family and social support; need for mechanical ventilation, hemodialysis, or intensive monitoring; severe dementia ; terminal malignant neoplasm; severe renal impairment; hepatic failure; serum hemoglobin level less than 9 g/dL; and planned cardiac surgery(eg, valve replacement). **Baseline characteristics of participants** Long list of demographic & clinical baseline – truncated GHHS vs. GMV Mean age 82.2 (5.2) vs. 80.1(4.9) p=0.04 Male (%) 22(46) vs. 30 (57) Married (%) 22 (46) vs. 24 (45) Family support at home (%) 48(100) vs. 53(100) Length of disease (yr) 5.4 (4.7) vs. 5.2 (4.7) plus clinical symptoms both cardiovascular & general including functional status (Barthel index) depression (GDS) MMSE, MNA, comorbidity measured by CIRS 3.6 (1) vs. 3.4 (2) All ns except age	**Outline of intervention** The team has 7 cars, is multidisciplinary and consists: 4 geriatricians, 13 nurses, 3 physio-therapists, 1 social worker &1 counselor working together as a team, with daily meetings 7 days a week. In ED all necessary diagnostic tests are provided and then the patient moves home by ambulance, usually within a few hours. Medical consultation with other hospital specialists is possible in the hospital or at the home of the patient. Treatments included physician and nurse visits, standard blood tests, pulse oximetry, spirometry, electrocardiography, echocardiography etc (as per hospital) Patients treated at home and family members obtained adequate Education e.g. early recognition of symptoms. Protocols for prevention of nosocomial infections, bed sores, and immobilization are routinely adopted for frail elderly inpatients. In the first days after admission to GHHS patient was visited at home on a daily basis by physicians and nurses. In the following days this care is tapered off as appropriate Consultation with cardiologists or other hospital specialists was possible. Physicians and nurses were available at all times for urgent home visits.	**Outline of control** The inpatient control group (GMW) received routine hospital care. Protocols for prevention of nosocomial infections, bed sores, and immobilization are routinely adopted for frail elderly inpatients.	**Relevant measures & outcomes** ***Primary outcome*** Mortality at 6 months. ***Secondary outcomes*** morbidity (infections, delirium, bed sores, deep vein thrombosis, and falls) during hospitalization, admissions to a nursing home, and subsequent hospital admissions related to any cause	***Primary outcomes*** Patient mortality at 6 months was 15% in the total sample, without significant differences between the 2 settings of care. (7 vs. 8 deaths) ***Secondary outcomes*** The number of subsequent hospital admissions was not statistically different in the 2 groups 8 (17%) vs. 18 (34%) mean (SD) time to first additional admission was longer for the GHHS patients (84.3 [22.2] days vs 69.8[36.2] days, *P*=.02). Only the GHHS patients experienced improvements in Depression (GDS) +1.48 (1.860 vs. +0.12 (3.36) p=0.02) nutritional status (MNA) -0.86(1.12) vs. -0.27 (1.78) p=0.05 Quality-of-life(NHP) +1.09 (2.57 vs. +0.18 (1.94) p=0.046

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Ricauda 2008 Italy COPD	**Single blind RCT** **Intervention:** Geriatric home hospitalization service (GHHS, n=52) **Control:** General medical ward (GMW, n=52)	**Inclusion criteria:** Patients ≥75 yrs with a diagnosis of acute exacerbation of COPD, defined on Anthonisen criteria as an increase in breathlessness, sputum volume, or purulence for at least 24 hours, admitted to the ED & requiring hospitalization. Additional inclusion criteria were appropriate care supervision in the home, telephone connection, living in the HaH & informed consent. **Exclusion criteria** Absence of family and social support; severe hypoxemia (partial pressure of oxygen <50 mmHg); severe acidosis or alkalosis (pH <7.35 or >7.55); suspected pulmonary embolism; suspected myocardial infarction; severe comorbid illness as defined by presence of need for hemodialysis, severe renal impairment (glomerular filtration rate <20 mL/min), cancer (except skin cancer), hepatic failure, or severe dementia (Mini-Mental State Examination score <14). **Baseline characteristics of participants** Intervention vs. control Age, mean ±SD 80.1 ±3.2 79.2 ± 3.1p=0 .20 Male, n (%) 29 (56) 39 (75) p=0.06 Married, n (%) 27 (52) 29 (56) .84 Family support n (%) 52 (100) 52 (100) p=0.89 Current smoker, n (%)7(13)6(11) p=0.97Ex-smoker, n (%) 34 (65) 35 (67) p=0.95 FEV1, mean ±SD 0.92 ±0.4 1.04 ± 0.5 p=0.18 % of predicted FEV1 38, 47 Home oxygen use, n(%)18 (35)12 (23) p=0.45 Arterial blood gas, mean ±SD pH 7.40 ± 0.04 7.41 ± 0.03 .19 PP of O_2 69 ± 19 65 ±±14 .p= 0.23 PP of CO_2 44 ± 12 46 ± 12 .47 ADL score, mean ± SD± 2.3 ± 2.2 1.9 ± 2.2 p=0.36 IADL score, mean ± SD 7.1 ± 4.9 8.1 ± 4.2 .27 GDS score, mean ± SD 16.1 ± 6.1 17.2 ± 6.8 .45 Comorbidity index 2.6 ± 1.5 3.0 ± 1.8 p=0.24	**Outline of intervention** **Intervention delivered by;** **"**a physician-led substitutive hospital-at-home model of care" Patients assigned to HaH were immediately transferred home by ambulance. At home, a multi-dimensional geriatric assessment was conducted & patients received hospital-level treatment& services, as their condition dictated. (Physician and nursing visits, standard blood tests, pulse oximetry, electrocardiogram, spirometry,echocardiogram, echographs and Doppler ultrasonographs,oral & intravenous medication administration, including antimicrobials & cytotoxic drugs, oxygen therapy, blood products transfusion, central venous access, surgical treatment of pressure sores, physical therapy & occupational therapy The HaH program emphasized patient & caregiver education about the knowledge of the disease, giving advice about smoking cessation, nutrition,management of activities of daily living & energy conservation, understanding & use of drugs, health maintenance, & early recognition of triggers of exacerbation that required medical intervention.	**Outline of control Intervention delivered by:** The inpatient control group received routine hospital care	**Relevant measures & outcomes** ***Primary outcomes*** Hospital readmission & mortality rates at 6 months. ***Secondary outcomes*** Depression status -Geriatric Depression Scale, functional status- Katz activities of daily living & Lawton instrumental activities of daily living Cognitive status -Mini-Mental State Examination, Quality of life -the Nottingham Health Profile Nutritional status -Mini Nutritional Assessment, Caregiver characteristics - Relatives' Stress Scale, & satisfaction using ad hoc questionnaire for Scale. Costs of care were compared for the acute episode.	***Primary outcomes*** GHHS vs. GMW Hospital readmissions at6mths 42% vs 87%, P= 0.001 Cumulative mortality at 6 mths was 20.2% in the total sample, No significant differences between grps. ***Secondary outcomes*** Mean length of stay 15.5 ±9.5 vs 11.0 ± 7.9 days, P= 0.010 Only GHHS patients experienced improvements in depression and QoL scores but ns between grps There were no differences in functional, cognitive, nutritional, or caregiver burden outcomes. Satisfaction at discharge was very good or excellent for 94% vs. 88% (P=0.83) (On a cost per patient per day basis, ($101.4 ± 61.3 vs $151.7 ± 96.4, P=0.002).

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Rodriguez-Cerillo 2009 Spain non-massive Pulmonary embolism	**COS** **Intervention:** Home hospitalization (HH) (n=30) **Control:** Conventional Hospitalization (CH) (n=31)	**Inclusion criteria:** *For trial* Non-massive pulmonary embolism • No contraindications for treatment with low MW heparin • Absence of moderate to severe renal failure • Haemodynamic stability • O2 saturation higher than 92% breathing room air • No signs of heart failure • No arrhythmia • No haemoptysis *For HH* • Agreement to admission to our HH unit • A valid caregiver at home • Residence in our health area • A condition amenable to home management **Exclusion criteria** massive PE, haemodynamic instability, oxygen saturation lower than 92% on room air, heart failure, haemoptysis, arrhythmia & contraindication for treatment with low MW heparin **Baseline characteristics of participants** Age 66.8 (27–91) 66.7 (31–90) n.s Sex (males) 30% 54.8% n.s Diagnosed neoplasm 13.3% 9.7% n.s Associated DVT 40% 29% n.s Prior TED 0% 19.3% 0.05 Dementia 23.3% 6.4% n.s. Hypertension 30% 45.1% n.s. Ischaemic heart disease 6.6% 9.6% n.s. Thrombophilia 3.3% 0% n.s Recent surgery 3.3% 6.4% n.s Unilateral involvement 70% 61.3% n.s Bilateral involvement 30% 38.7% n.s Diagnosed by helical CT 26.6% 38.7% n.s	**Outline of intervention** **No detail**	**Outline of control** **No detail**	**Relevant measures & outcomes** No distinction between Primary and secondary outcomes Major and minor bleeding Re-thrombosis, Clinical course Unexpected returns to hospital Need for hospital re-admission in the following 3 months.	All comparisons ns Mean stay length HH vs. CH 8.9 days (7–14 days), vs. 10.6 days (6–20 days). All patients in study had a favourable clinical course. No major bleeding, re-thrombosis, or death occurred. One patient on HH experienced an abdominal wall haematoma in the area of administration of the low MW heparin. One patient admitted to hospital experienced a haematoma in the right arm related to blood sampling for laboratory tests. No patient with HH had infectious complications. Three patients admitted to hospital were diagnosed of urinary tract infection. No HH patients required unexpected return to hospital during admission. During follow-up, two patients required hospital admission, one in each group. The cause was not related to the thromboembolic disease.

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Carratala 2005 Spain Pneumonia	**Open RCT** **Intervention:** Outpatient care with oral levofloxacin therapy or hospitalization with sequential intravenous and oral levofloxacin therapy. (n=110) **Control:** Hospitalisation (n=114)	**Inclusion criteria:** All immunocompetent patients who were at least 18 years of age and had received a diagnosis of community acquired pneumonia in the emergency department (24 hrs per day, 7 days per week) Community acquired pneumonia was defined as the presence of a new infiltrate on chest radiography plus at least 1 of the following: fever (temperature ≥38.0 °C) or hypothermia (temperature <35.0 °C), new cough with or without sputum production, pleuritic chest pain, dyspnea, or altered breath sounds on auscultation. **Exclusion criteria** Neutropenia, HIV infection, transplantation, or splenectomy or who were taking immunosuppressive drugs **Baseline characteristics of participants** Male 69 (62.7) 66 (57.9) Female 41 (37.3) 48 (42.1) Mean age ± SD, *y* 67.5 ± 11.8 64.9 ± 13.4 Alcohol consumption ±80 g/d, *n (%)* 13 (12.4) 7 (6.4) Current tobacco smoking, *n (%)*‡ 21 (19.8) 24 (21.8) Influenza vaccine in current season, *n (%)*§ 44 (42.7) 49 (46.2) Pneumococcal vaccine in the previous 5 yrs, *n (%)*± 15 (15.6) 13 (13.1) Comorbid conditions, *n (%)* 71 (64.5) 78 (68.4) Mean oxygen saturation ± SD, *%* 94.5 ± 2.0 94.5 ± 1.8 Multilobar pneumonia, *n (%)* 8 (7.3) 9 (7.9) Risk class, *n (%)* II 55 (50.0) 63 (55.3) III 55 (50.0) 51 (44.7) Mean PSI score ± SD 70.0 ± 11.6 66.9 ± 12.5	**Outline of intervention** Outpatients were given oral levofloxacin (500 mg/d), and received detailed written information about their pneumonia diagnosis and their treatment plan, as well as emergency contact telephone numbers for a nurse or investigator physician. Patients were visited at home by a nurse 48 hours after emergency department discharge. The visit included assessment of vital signs and measurement of oxygen saturation by pulse oximetry. If the nurse thought that a patient's condition was not improving (worsening of baseline vital signs, oxygen saturation, or both), one of the investigators made an additional visit. The nurse was involved only in outcome assessment. Patients were seen at the outpatient clinic at days 7 and 30 after pneumonia diagnosis.	**Outline of control** Hospitalized patients received sequential intravenous and oral levofloxacin (500 m and received detailed written information about their pneumonia diagnosis and their treatment plan, as well as emergency contact telephone numbers for a nurse or investigator physician g/d) Patients assigned to hospitalization were seen daily during their hospital stay by attending physicians and by at least 1 of the investigators. Criteria for early switching from intravenous to oral levofloxacin were a respiratory rate of 24 breaths/min or less, a pulse rate of 100 beats/min or less, a temp of 37.8 °C or lower on 2 occasions at least 8 hours apart, and maintenance of adequate oral intake. Physicians were advised to discharge patients after their clinical condition stabilized, in accordance with previously recommended criteria. Patients were seen at the outpatient clinic at days 7 and 30 after pneumonia diagnosis.	**Relevant measures & outcomes** ***Primary outcomes*** % of patients with an overall successful outcome at the end of treatment, according to 7 predefined criteria: cure of pneumonia (as defined later), absence of adverse drug reactions, absence of medical complications during treatment, no need for additional visits, no changes in initial treatment with levofloxacin, **absence of subsequent hospital admission in the 30 days after randomization**, and absence of death from any cause in the 30 days after randomization. ***Secondary outcomes*** Patients' quality of life & satisfaction	Intervention vs. control ***Primary outcome*** Successful outcome was achieved in 83.6 vs. 80.7% (absolute difference, 2.9 % points [95% CI, ±7.1 to 12.9 % points]). % patients with adverse drug reactions (9.1% vs. 9.6%), Subsequent hospital admissions (6.3% vs. 7.0%), Overall mortality (0.9% vs. 0%) Medical complications (0.9% vs. 2.6%), ***Secondary outcomes*** All ns Quality of life (9.1% vs. 9.6%) Satisfied with overall care (91.2% vs. 79.1%; absolute difference, 12.1% [CI, 1.8 to 22.5 % points]).

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Kalra 2005 UK Stroke	**RCT** **Intervention:** **1)ST (n=152)** The stroke team involved management on general wards with specialist team support. The team undertook stroke assessments and advised ward-based nursing and therapy staff on acute care, secondary prevention and rehabilitation aspects. **2) DC (n=153)** **Domiciliary care provided management at home under the supervision of a GP and stroke specialist with support from specialist team and community services. Support was provided for a maximum of 3 months**. **Control:** Usual care **SU (n=152)** The stroke unit provided 24-hour care provided by a specialist multidisciplinary team based on clear guidelines for acute care, prevention of complications, rehabilitation and secondary prevention.	Patients were included within 72 hours of stroke onset. The research team was notified by telephone or fax by GPs for patients at home, and by accident and emergency (A&E) services for suspected stroke patients presenting to the casualty department. **Inclusion criteria:** Patients with disabling stroke who could be supported at home with nursing, therapy and social services input on initial assessment were included in the study. **Exclusion criteria** Patients with mild stroke, severe strokes, already admitted to hospitals, and those with unusual or atypical neurological features who required specialised assessments or investigation to establish a diagnosis of stroke. Patients who were institutionalised or had severe disability (Rankin 4 or 5) before stroke **Baseline characteristics of participants SU vs. ST vs.HC** Median age (years) (IQR) 75 (72–84) 77.3 (71–83) 77.7 (67–83) No. of females (%) 69 (46.6) 76 (50.6) 68 (45.6) Living alone (%) 50 (33.7) 55 (36.6) 50 (33.5)	**Outline of intervention** **ST** Patients were managed on general wards & under care of admitting physicians. All patients were seen by specialist team: doctor (specialist registrar grade), a nurse (grade G), a physiotherapist (senior I) and an occupational therapist (senior I) with expertise in stroke management. Patients were assessed by the specialist team, which undertook a diagnostic evaluation and assessment for needs. Ward provided the day-to-day treatment, the team advised on specialist aspects of stroke care. It reviewed progress and treatment of individual patients with ward team & helped in discharge planning and setting up of post discharge services. The team provided counselling, education and support to the family, identified expectations and advised about realistic outcomes in the context of previous morbidity and present deficits. **DC** Patients were managed in own home by a specialist team consisting of a doctor (specialist registrar), a nurse (G grade) & therapists (senior I grades), with support from district nursing and social services for nursing and personal care needs. Patients were under the joint care of the stroke physician and GP. Investigations, including CT scanning, were performed in outpatient s. Therapy was provided by members of the specialist stroke team. Each patient had an individualised integrated care pathway outlining activities and the objectives of treatment, which was reviewed at weekly multi-disciplinary meetings.	**Outline of control** **SU** Care was provided by a stroke physician supported by a multidisciplinary team with specialist experience in stroke management. There were clear guidelines for acute care, prevention of complications, rehabilitation and secondary prevention, and a culture of joint assessments, goal setting, coordinated treatment and discharge planning. A coordinated multidisciplinary approach was adopted towards rehabilitation, with emphasis on early mobilisation. All patients had an individualised rehabilitation plan with clearly defined goals based on joint assessments. Patient participation was encouraged, with focus on motivation and providing an enriched environment.	**Relevant measures & outcomes** ***Primary outcomes*** Death or institutionalisation at 1 year. Dependence - modified Rankin Scale (mRS), ***Secondary outcomes included*** Orgogozo scale, BI and FAI for disability, the mRS for handicap EuroQol-quality of life of patients and their carers.	Mortality and institutionalisation at 1yr were lower on SU vs.ST or DC Significantly fewer patients on SU died compared with ST The proportion of patients alive without severe disability at 1 year was also significantly higher on SU vs. ST or DC. These differences were present at 3 & 6 mths after stroke. Stroke survivors on SU showed greater improvement on basic activities of daily living compared the other two grps. Achievement of higher levels of function was not influenced by strategy of care. QoL at 3mths was significantly better in SU & DC patients. There was greater dissatisfaction with care with ST vs. SU or DC. Poor outcomewith DC and ST was associated with Barthel Index <5, incontinence and with ST, age >75 years. The total costs of stroke per patient over 12mths were £11,450 for SU, £9527 for ST & £6840 for DC The mean costs per day alive for the SU were significantly less than those for the ST , but no different from DC patients. Costs for DC were significantly less than for those managed by the SU or ST.

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Rodriguez-Cerrillo 2013 Spain uncomplicated diverticulitis	**Prospective controlled study** **Intervention:** Patients stayed 24 h in the Observation Ward within ED prior to discharge and treatment at home. (n=34) **Control:** Traditional hospitalization (n=18)	**Inclusion criteria:** ≥70 years diagnosed with uncomplicated diverticulitis (The existence of abscess, fistula, bowel obstruction and peritonitis) Patients who were willing to be treated at home and had a caregiver 24 h a day were transferred to HaH. The rest of the patients were admitted to conventional hospitalization. **Exclusion criteria** Patients with complicated diverticulitis, β-lactam allergy or who required admission to hospital for other pathology **Baseline characteristics of participants** intervention vs. control Age 77 (71–90) 79 (71–98) Sex (female) 28 (82.4%) 16 (84.2%) Cardiopathy 9 (26.5%) 6 (31.6%) Diabetes mellitus 4 (11.7%) 2 (10.5%) Chronic renal failure 4 (11.7%) 1 (5.2%) Neoplasm 1 (2.9%) 1 (5.2%) COPD 1 (2.9%) 1 (5.2%) Corticosteroids 4 (11.7%) 2 (10.5%) Previous diverticulitis 7 (20.5%) 3 (15.8%) Abdominal pain 34 (100%) 19 (100%) Fever 9 (26.5%) 6 (31.6%) Diarrhea 6 (17.6%) 3 (15.8%) Leucocytosis 7 (20.5%) 3 (15.8%)	**Outline of intervention** **Intervention delivered by;** All patients were given Ertapenem after diagnosis. Patients in HaH grp stayed 24 h in the observation ward within ED prior to discharge. At home, nurses administrated Ertapenem every day. The physician conducted 2–3 home visits per week, depending on the patient's clinical course. On admission patients were provided with a phone number to contact the unit if any problem arose. Intravenous antibiotic was changed to oral therapy (amoxicillin–clavulanate) after 4–6 days of treatment until complete 10 days of treatment.	**Outline of control** **Intervention delivered by:** All patients were given ertapenem after diagnosis & experienced traditional hospitalisation	**Relevant measures & outcomes** No primary nor secondary outcomes were defined	A small amount of free fluid was present in 38% of patients treated with HaH and 42% of patients in hospital. All patients had a good clinical evolution. None of the patients treated with HaH needed be transferred to hospital. Mean stay was 9 days in HaH vs. 10 days in Hospital. The cost of each patient with diverticulitis treated at home was 1368 euros cheaper than the cost of a patient treated in the hospital (fewer staff and important reduction of maintenance costs).

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Leff **[3066]** **2005** **USA** **Plus** Leff 2009 [2545] Frick 2009 [0158]	**Prospective quasi experimental** 2 consecutive 11 month phases **Intervention:** Treatment in a hospital-at-home model of care that substitutes for treatment in an acute care hospital. Offered In the 2nd phase of study n=169 **Control:** Described as 'observation group' in the first phase of study. Eligible patients were identified and followed through usual hospital care. n=286 **Aim:** 'to evaluate the safety, efficacy, clinical and functional outcomes, patient and caregiver satisfaction, and costs of providing acute hospital level care in a hospital at home that substituted entirely for admission to an acute care hospital for older persons.' **Setting:** **Intervention** (if received): At home **Control** **Secondary hospital care** ***Power calculation***: No	**Inclusion criteria:** Community-dwelling persons ≥65 yrs old, Lived in catchment area In the opinion of a physician not involved in study, required admission to an acute care hospital for these illnesses: community-acquired pneumonia, exacerbation of chronic heart failure or chronic obstructive pulmonary disease, or cellulitis. Required to meet validated criteria of medical eligibility for hospital-at-home care. **Exclusion criteria** Most common reasons for medical ineligibility were uncorrectable hypoxemia, suspected myocardial ischemia, and presence of an acute illness, other than the target illness, for which the patient was required to be hospitalized. **Baseline characteristics of participants at all sites (Stats shown if signif)** Observation vs. intervention Age (SD) 77.3 (6.6) vs.77.2(7.0) % female 34 vs. 42% % white 90 vs.86% **% in poverty 11 vs.19% p=0.027** **% live alone 43 vs.33% p=0.022** Mean mini mental state (SD)25.5 (4.2) vs. 25.2(4.4) Mean Charlson score (SD) 3.1 (2.0) vs.3.0 (1.8) **Mean medications (SD) 6.8 (3.9) vs. 8.1(4.5) p=0.002** %Primary admission diagnosis Pneumonia 31vs. 32% COPD 32 vs.28% Cellulitis 12 vs 18% CHF 25vs.22%	The study was conducted in 3 Medicare managed care (Medicare +Choice) plans at 2 sites and at a Veterans Administration medical centre. Univera Health and Independent Health, in Buffalo, New York, are Medicare + Choice plans These 2 plans collaborated to provide hospital- at-home care and made up 1 study site (site 1). The Fallon Health Care System (site 2), in Worcester, Massachusetts, operates a not-for-profit Medicare +Choice plan, and the Fallon Clinic, a for-profit multispecialty physician group, provides care on a capitated basis to Medicare + Choice beneficiaries. The Portland, Oregon, Veterans Administration Medical Center (site 3) is a quaternary care and teaching facility. A patient requiring admission to the acute care hospital for a target illness was identified in an ED or ambulatory site and his or her eligibility status was determined. Non-study medical personnel, usually ED physicians, made the decision to hospitalize the patient. All patients who were offered but who declined hospital-at-home care were admitted to the acute care hospital. Study coordinators verified the patient's eligibility for HaH using a standard protocol at enrolment. Most patients were identified the morning after admission.	**Outline of intervention &who delivered** 1 Nov 2001-30 Sep 2002 Patients evaluated by HaH physician either in ED or after ambulance transfer to home. HaH nurse met ambulance at patient's home and provided direct one-on-one nursing for an initial period of ≤ 8hrs at site 3 and ≤24 hrs at sites 1 & 2. followed by intermittent nursing visits and HaH physician at least daily. HaH physician was available 24 hours a day for visits. Nursing and other care components, e.g. durable medical equipment, oxygen therapy were provided and some services e.g. home radiology, support provided by independent contractors. Lifeline devices were provided for patients living alone. Diagnostic tests , IV fluids, IV antimicrobial agents, etc. and oxygen/respiratory therapies were provided at home. Patient was followed by same physician until discharged to primary care	**Outline of control** 1 Nov 1990- 30 Sep 2001) Eligible patients identified & followed through usual hospital care.	**Relevant measures & outcomes** **No distinction between primary and secondary outcomes** Intervention group comprised all patients eligible for hospital-at-home care, irrespective of where they were treated. [thus some outcomes are NOT useful to us but some measures are HaH specific] **Mean LoS (SD) days [Leff 2005]** ***Mean time in ED (SD) in hrs*** ..... Sub-analysis of HaH vs. Non-HaH (i.e. different to main report [Leff 2009] ***Changes in ADL and IADL from 1mth before admission -2 weeks after intervention*** **Costs** ***Within each health system and per condition*** [Frick 2009] **Overall summary** 'The HaH care model is feasible, safe, and efficacious for certain older patients with selected acute medical illnesses who require acute hospital-level care.' Leff 2005 HaH care is associated with modestly better improvements in IADL status and trends toward more improvement in ADL status than traditional acute hospital care. Leff 2009 Total costs seem to be lower when substitutive HaH care is available for patients with CHF or COPD disease.Frick2009	Intervention vs. control **Mean LoS (SD) days** **4.9 (9.9) 3.2 (2.5) p =0.004** ***Mean time in ED (SD) in hrs*** **6.4(1.8,11.6)SD 1.9 vs. 5.5(1.0,21.3) SD3.2** **P=0.001** [Leff 2005] ---------- ***Changes in ADL and IADL from 1mth before admission -2 weeks after intervention*** ADL 0.39(3.13) vs. -0.6(3.09) p=0.1 **IADL 0.74(2.86) vs. -0.70(2.68) p=0.007** [Leff 2009] --- **Costs** ***Within each health system and per condition*** **Mean (SD)** Overall **$5081(4427)vs.$7480(8113) p<0.001** Pneumonia $5272(6036) vs. $6761(6451) NS Congestive heart failure **$3310(2118) vs. $6399(6643) p≤0.001** COPD **$4293(3806) vs. $6500(7305) p≤0.05** Cellulitis $4262(2309) vs. $7287(11471) NS [Frick 2009]

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Crilly 2010 Australia	**'quasi experimental'** **[Controlled (his) study]** **Intervention:** Hospital in the nursing home (HINH) n=62 **Control:** Usual in-hospital care n=115	**Inclusion criteria:** Reside in an ACF. Have a signed GP request for HINH review from the ACF. Be of any age (usually≥ 65 yrs). Present with an illness that required hospital services but not necessarily admission e.g. UTI & could have treatment e.g. antibiotics continued by ACF staff. Prior to start of HINH, patients who would have fit inclusion criteria for hospital admission **Exclusion criteria:** ACF residents who required extensive treatment that could not be managed in ACF or who required specific services that could only be received in hospital e.g. surgery **Baseline characteristics of participants** **HINH vs. Control** Age (SD) 85(7.1) vs.84.6(6.6)years Triage category 3.2 (0.7) vs.3.2(0.7) Female 76vs. 75% Diagnostic category: Respiratory 24 vs.26% Cellulitis 18 vs.17% Kidney/urinary tract 18vs.16% Cardiac 10 vs. 10 % Abdominal/GI 8vs.8% Viral/sepsis 7 vs.6% All other 16 vs.17%	In the ED. Enrolments were made by HINH programme manager (registered nurse) with programme director (ED director), GPs and ACF nursing staff, as appropriate. After hours and on weekends, if patient was suitable for HINH , they stayed in ED short stay unit and were reviewed by HINH nurse on next weekday. **Outline of intervention** The HINH nurse checks with the ACF registered nurse and patient on the patients' progress initially on a daily basis and then every couple of days. Discharge occurs when required treatment has ceased. This completes the patients' hospital-affiliated episode. **Intervention delivered by:** HINH programme delivers acute care nursing support services, medication and equipment to the ACF registered nurse and/or enrolled nurse. These services may include initial training and education regarding antibiotic or IV fluid administration; specific wound treatment and dressing procedure (with dressing materials); suprapubic catheter care, behaviour management and palliative care.	**Outline of control** The comparison group was selected from patients who presented to ED and were subsequently admitted during the same time period. To be included in this group, the patients had to reside in an ACF and be aged ≥65yrs. ACF residents who presented to the ED were in some cases not enrolled in HINH because they had a medical problem that was judged as possibly requiring in-hospital admission services beyond those offered by the HINH. **Intervention delivered by:** No details but presumably usual hospital staff	**Relevant measures & outcomes** ***Hospital LOS (days)*** ***ED LOS (hours)*** ***Episode of care (total time) LOS (days)*** ***Long (≥6days) vs. short hospital LOS*** ***Long (≥8 days) ED LOS vs. short*** ***Long episode of care (≥6 days)*** ***Hospital readmissions within 28 days*** ***Costs*** None	HINH vs. Control Mean (SD) ***Hospital LOS*** **2.19 (0.82) vs.6.2(0.59) days p<0.001** ***ED LOS*** **9.94(0.66) vs. 7.01(0.47) hrs p=0.005** ***Episode of Care LOS*** 9.56(1.26)vs. 6.20(0.59) days p=0.14 Percentages ***Hospital LOS 6+days*** **9.6 vs. 40 p<0.001** Episode of care 6+days 46.8 vs.40.0 p=0.35 ***LOS in ED 8+ hours*** **50.0vs.33.9 p=0.05** ***Readmission in 28 days*** 11.3 vs. 11.3 p=0.99

Author Year Country	Study	Participants	Intervention	Control	Outcomes assessed	Results
Lau **2013** **Australia**	**Controlled (his) Case series** **Intervention** Treatment in residential care facilities (TRC) grp **n=95** **Control** Hospital-based aged care unit (ACU) **n=167**	**Inclusion criteria:** Patient and/or family consent Capacity within HITH to accept the patient Facility able to manage the care needs of the patient in the residential aged care facility (RACF) **Exclusion criteria:** Lack of consent from patient and/or family. Behavioural disturbances, which may prevent the delivery of care e.g. aggressive behaviour and frequent removal of IV, access device. History of recent falls, which may impact on the delivery of care in the RACF. If there was conflict regarding management, further input and discussion were carried out in ACU. **Baseline characteristics of participants** TRC vs. ACU **Age** 83.5 vs.82.8yrs **Female** 53 vs.59% **Non-English speaking** 42 vs.48% **High level of nursing homecare** 72 vs.76% **Dementia 77.9vs.45.5% p<0.001** **Charlson score** 7.1 SD 1.9 vs. 7.2 SD 2.3	In the ED the acuity of presenting complaint was triaged to maximize service capacity. Overnight referrals were assessed next morning, (those who presented after hours were put in Short Stay Unit adjacent to ED for assessment. TRC generally provided once daily visits for patient. The geriatrician & team members would use clinical judgement to determine if a patient was suitable for TRC **Outline of intervention** Treatment in Residential Care facilities (TRC) delivered by the Residential Care Intervention Program into the Elderly (RECIPE) service between July-Oct 2008. **Appropriate Clinical Diagnosis** Dehydration, Pneumonia, Urinary Tract Infection, Gastroenteritis, Deep Venous Thrombosis, Terminal care support. **Treatment can therefore include any of the following:** IV antibiotics & IV fluids Anticoagulation Oxygen therapy (low flow) Appropriate Allied Health intervention Palliative support* Referral to other appropriate support programs * [TRC also offered palliative care as appropriate. If patient's condition changed and management could not be continued, transfer into acute hospital was organized. If patients had uncertain prognosis, treatment was given, followed by palliative care if no response despite optimal treatment.] **Intervention delivered by:** Geriatrician, registrar and nursing staff with access to allied health staff such as physiotherapy, OT, speech pathology and social work.	**Outline of control** Aged care unit (ACU) Inpatients treated in ACU in preceding year July-October 2007, before existence of TRC. ACU is a service for inpatients who have been admitted from residential care facilities for the management of general medical conditions. **Intervention delivered by:** No details but presumably usual hospital staff	**Relevant measures & outcomes** ***Palliative care*** ***Mortality on discharge*** ***6-month mortality*** ***Rehospitalisation within 1-month*** ***Total hospitalisation at 6 months*** **Length of hospital care/stay** All measured as 'present or not' **Costs** None	TRC vs. ACU ***Palliative care*** **34 (35.8%) 13 (7.8%) <0.001** ***Mortality on discharge*** 11 (11.6%) 20 (12.0%) p=0.924 ***6-month mortality*** 29 (30.5%) 51 (30.5%) p=0.184 ***Re-hospitalization within 1 month*** 20 (21.1%) 35 (21.0%) p=0.986 ***Total re-hospitalization at 6 months*** 39 (41.1%) 68 (40.7%) p=0.963 ***Length of stay*** **Mean (no SD given) 2vs.11 days** **P<0.001** Equivalent of 270 vs. 1840 bed days

UNIVERSITY of York
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Health Research

PROSPERO International prospective register of systematic reviews

A systematic review to identify and assess the effectiveness of hospital alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission

Alyson Huntley, Melanie Chalder, Will Hollingworth, Chris Metcalfe, Ben Davies, Sarah Purdy

Citation

Alyson Huntley, Melanie Chalder, Will Hollingworth, Chris Metcalfe, Ben Davies, Sarah Purdy. A systematic review to identify and assess the effectiveness of hospital alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission. PROSPERO 2015:CRD42015020371 Available from http://www.crd.york.ac.uk/PROSPERO_REBRANDING/display_record.asp?ID=CRD42015020371

Review question(s)

1) What admission alternatives are there for older patients and do they improve patient outcomes e.g. mortality, quality of life?

2) What are the defining characteristics of those older patients for whom the decision to admit to hospital may be unclear?

Searches

MEDLINE, MEDLINE in process, EMBASE, CINAHL and the Cochrane Central Register of Controlled Trials (CENTRAL) from 2005 to April 24th 2015. The Kings Fund and AHRQ websites were also searched

Types of study to be included

Any type of controlled study

Condition or domain being studied

Any condition that may result in an avoidable hospital admission in patients over the age of 65.

Participants/ population

People over 65 years of age of either sex living in OECD countries who are at risk of an unplanned admission (probably for an ambulatory sensitive condition) - they will therefore not be admitted to hospital at time of recruitment but could be in community or emergency department (being assessed).

Intervention(s), exposure(s)

The intervention of interest is admission to hospital, using definitions developed for previous studies (Huntley et al, Family Practice Fam Pract. 2013 Jun;30(3):266-75.). However it is important to point out that admission is likely to be the control group in many relevant studies.

Comparator(s)/ control

Alternatives to admission (likely to be described as the intervention) including but not limited to: hospital at home, virtual ward, rapid response nursing, care at home, admission to a care home, usual care.

Context

Reducing emergency bed days is one of the biggest challenges currently facing the National Health Service (NHS). There is considerable pressure to reduce hospital admissions amongst older people (D'Souza, BMJ 2013). There has been a 65% increase in hospital admissions for those over 75 years of age in the last decade ,and the oldest old, those over 85 years , now account for 11% of emergency admissions and 25% of bed days (NHS England 2013). There are some older people for whom care in the community is safe,perhaps with the provision of additional services and some for whom admission is required in order to deliver diagnostic or treatment techniques that are only available as an in patient. This review seeks to identify interventions for those patients that do not fall neatly into one of these categories and in doing so will assess the efficacy of the interventions and provide more detail on this patient

population.

Outcome(s)

Primary outcomes

1) Patient outcomes (including mortality, quality of life, length of stay, readmission, adverse effects of intervention) plus costs if available.

2) Patient characteristics for whom their pathway (admission or not) is unclear including risk factors e.g. co-morbidities (mental & physical), age, gender, social circumstances ,disease severity, recent admission/discharge availability of other services

Secondary outcomes

None

Data extraction, (selection and coding)

Standardised data extraction forms will be developed using existing guidelines (Higgins 2008 Cochrane handbook chapter 7 section 7.5). Data will be abstracted by one reviewer. A second reviewer will check data abstraction against the original paper. Data items: details on participants, Interventions, comparisons,outcome measures

Risk of bias (quality) assessment

Cochrane risk of bias tool will be used for randomised controlled trials. CASP criteria will be used for controlled trials

Strategy for data synthesis

Meta-analysis of data will be performed using Review Manager Version 5.1 if there are at least three trials with combinable data with a fixed or random effects model depending on the level of between trial heterogeneity estimated using the I-squared statistic. Sensitivity analysis will be performed as the data dictates.

Analysis of subgroups or subsets

Dependent on data found

Dissemination plans

This review is part of programme development grant.

Contact details for further information

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Details of any existing review of the same topic by the same authors
None

Anticipated or actual start date
02 February 2015

Anticipated completion date
29 January 2016

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NIHR Programme Development Grant RP-DG-1213-10004

Conflicts of interest
None known

Language
English

Country
England

Subject index terms status
Subject indexing assigned by CRD

Subject index terms
Hospitalization; Hospitals; Humans

Stage of review
Ongoing

Date of registration in PROSPERO
14 May 2015

Date of publication of this revision
14 May 2015

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Stage of review at time of this submission	Started	Completed
Preliminary searches	No	Yes
Piloting of the study selection process	No	Yes
Formal screening of search results against eligibility criteria	Yes	No

Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Pages 2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Page 5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Pages 5-6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Page 6
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Page 6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Pages 6-7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Page 7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Page 7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Page 8

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Page 7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Page 8 and Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Pages 8-17
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Pages 8-17 and Appendices 2 & 3
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Pages 8-17 and Appendix 5
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Pages 8-17 plus narrative presentation
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Pages 8-17
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Page 18
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Pages 18-19
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Page 19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Page 21

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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